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WILDLIFE LABORATORY

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JOB PROGRESS REPORT

State: Montana

Project No.: W-120-R-15 Project Title: Statewide Wildlife Research

Element No.: VI Element Title: Wildlife Investigations Laboratory

Sub-project No.: 2 Sub-project Title: Research and Technical Services

Study No.: WI-1.0 Study Title: Wildlife Laboratory

Job No.: 1 Job Title: Statewide Wildlife Laboratory Services

Period Covered: July 1, 1990 - June 30, 1991

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Date: November 1, 1991

Since this is a progress report only, results presented herein are not necessarily final and may be subject to change. For this reason, the information contained in this report may not be published or used for other purposes without permission of the Director.

ABSTRACT

The Wildlife Laboratory processed 174 general wildlife specimens and 630 hunter/trapper specimens. Approximately 1,000 big game and furbearer samples were analyzed for food habits. Blood samples from over 600 animals of several species were analyzed for disease and chemistry profiles. Blood serum and reproductive tracts from 300 animals of several species were analyzed for reproductive performance. Approximately 400 skulls were processed. Over 900 teeth were processed for age determination by cementum annuli counts. Ages were determined for 330 pine marten (*Martes americana*) and 200 mountain lion (*Felis concolor*). Tests were conducted on aging techniques for these two species. Animal immobilization throughout the state was coordinated. Biological measurements, blood, and tissue were collected from bison harvested during the 1990-91 season. Fifty-three animal necropsies were conducted on a variety of species. A total of $19,746 was grossed during the sale of 113 hides, heads, and other items auctioned in the annual trophy sale. Forty-three requests for reference specimens and educational material were processed. The biotelemetry frequency database was updated and results reported to the FCC frequency coordination committee. Work continued on monitoring of wildlife parasites through cooperation with the Veterinary Molecular Biology Laboratory. Special research conducted included mountain lion studies, pine marten studies, and grizzly bear (*Ursus arctos*) studies. Wolf (*Canis lupus*), mountain lion, and grizzly bear mortalities were recorded. Management recommendations are presented.

INTRODUCTION

The Wildlife Laboratory has served research and management in this state since 1955. The laboratory provides important services to wildlife biologists in Montana and conducts critical research on topics which must be investigated within a laboratory setting. Its history has been dynamic, developing with the ever changing needs of the wildlife scientists within the state.

Wildlife Laboratory activities serve many functions. The work at the laboratory produces valuable resources used in the Montana Department of Fish, Wildlife and Parks (MDFWP) information and education programs. It provides data and conducts research important to decision makers in wildlife management programs. The laboratory coordinates with other laboratories conducting similar work in neighboring states and within the state. In addition, work at the wildlife laboratory assists law enforcement personnel during investigations of wildlife crimes.

This report summarizes the results of laboratory investigations for the period from July 1990 to June 30, 1991. The work conducted is ongoing and will continue into next fiscal year.

JOB OBJECTIVES

There are nine main job objectives for the Wildlife Laboratory:

1. Provide wildlife laboratory services to management and research biologists through determination of food habits, reproductive status, sex, and age of wildlife specimens submitted from throughout the state.

2. Necropsy wildlife specimens suspected of being diseased, parasitized, or dying of unknown causes to identify the probable cause of death. This includes submitting various tissue samples to appropriate laboratories for testing if warranted.

3. Coordinate and supervise MDFWP wildlife immobilizing drug program and conduct research on new drugs as they become available.

4. Maintain and add to reference collections of plant and animal materials.

5. Coordinate the MDFWP wildlife/pesticide program.

6. Coordinate and maintain a central file of radio frequencies being used to mark various species of wildlife throughout the state.

7. Obtain and prepare specimens to fill requests for study skins, tanned hides, mounted specimens, skulls, and other skeletal materials to be used by MDFWP personnel and others for educational displays and programs.

8. Assist other research and management biologists in construction of various animal markers and in capture and handling of animals.

9. Conduct special physiological investigations as requested:

    a. Test serological techniques of determining pregnancy in big game animals

    b. Test ultrasonic pregnancy detection devices for reliability and validity of detecting pregnancy in live big game animals

    c. Relate physiological parameters of wildlife specimens to range condition, climatological factors, population structure and size, and various management strategies.

METHODS

Food habits were determined using standard laboratory procedures: sampling, identification of food items using appropriate keys and known reference materials, volumetric measurement, and storage. Findings were returned to the original collectors for tabulation, interpretation, and final reporting.

Blood samples were obtained from big game animals during regular trapping and handling of animals for research or management purposes. Hematology and blood chemistry measurements were done by the Livestock Department's Veterinary Diagnostic Laboratory in Bozeman.

Female reproductive tracts were prepared for examination, ovaries for sectioning, and bacula and testes for development. Uteri were examined for scars and embryonic or fetal tissue. Blood serum samples were submitted to the University of Idaho for measurement of pregnancy-specific protein B levels.

Ages of big game animals were determined by tooth replacement and wear characteristics. Ages of bears, lions, and furbearers were determined by cementum annuli counts of sectioned teeth and/or skull characteristics. Radiographs were used to determine juvenile from adult pine marten (Nagorsen et al. 1988).

Skulls of harvested grizzly bears (*Ursus arctos*) and mountain lions (*Felis concolor*) taken statewide, and carcasses of marten (*Martes americana*) from throughout Montana were required or requested to be turned in. Skulls of bobcat (*Felis rufus*) trapped in Regions 2 and 3 were collected. Skulls from these animals, plus those of other lions, bears, and furbearers received in the lab, were cleaned by boiling and returned to the hunter/trapper if requested.

Hides, capes, antlers, horns, black bear (*Ursus americanus*) claws, and elk (*Cervus elaphus*) canine teeth were sold at a public auction held in April 1991.

Bear and goat (*Oreamnos americanus*) teeth were pulled, sheep (*Ovis canadensis*) and goat horns were measured, sheep horns were plugged for hunters, and furbearer pelts were tagged for trappers.

Various measurements and biological samples were taken from bison (*Bison bison*) taken by hunters or FWP personnel during the 1990-91 hunting season.

Liaison was maintained with other laboratories. Emphasis of this cooperation involved necropsy of specimens to determine cause of death and examination of wildlife for parasites and diseases. Tissues were collected to assist various research conducted in other laboratories throughout the United States. Primary labs involved are the Veterinary Diagnostic Lab and Veterinary Molecular Biology Lab, both in Bozeman.

Other labs to which specimens are sent include the National Wildlife Health Research Lab in Madison, Wisconsin, and the National Veterinary Services Lab in Ames, Iowa.

Statistical analysis was conducted using STATGRAPHICS software. Statistical significance indicates 95% confidence unless otherwise specified. Statistical tests used include ANOVA, Students t, or Chi-square as specified. Graphics were produced using HARVARD GRAPHICS software. Database management was conducted with DBASE III PLUS software.

RESULTS AND DISCUSSION

General Specimen Processing

A total of 174 general wildlife specimens were submitted to the laboratory for various processing (Table 1). General specimens include all non-trapper/hunter collections. Twenty-five species were represented in the list of specimens processed during the year.

Skeletal materials processed this year included 255 mountain lion skulls, 100 pine marten skulls, 25 furbearer skulls, 40 bobcat skulls, and 60 bear skulls.

Food Habits

Approximately 70 rumens were fixed and stored from deer (*Odocoileus* spp.) studies in the Bridger Mountains, Lee Metcalf Wildlife Refuge, and the Flathead Valley. Biologists from the Flathead studies have examined and recorded the findings in their reports. The remaining rumens are stored and awaiting identification of contents.

Over 800 grizzly bear scat samples were collected in four field projects and presented for analysis during the report period. The samples were accessioned, and analysis was conducted on contract by Wildlife Services Inc. (Kevin Frey). Coordination for processing these samples was provided by the MDFWP Wildlife Laboratory, and results were archived and disseminated to various projects.

Nearly 300 stomach and colon samples from various species were examined and their contents determined. Approximately 95% of these were from marten submitted by trappers. These data will be analyzed further and summarized in later reports. Results of analysis of contents of marten stomachs and colons collected from the 1989-90 trapper harvest are presented in the pine marten study section of this report.

The U.S. Fish and Wildlife Service (FWS) submitted 287 scats and miscellaneous skeletal materials collected near a wolf (*Canis lupus*) den and rendezvous site in the Ninemile Creek drainage, Missoula County. Other material submitted included one

Table 1. General specimens received and processed at the Wildlife Laboratory during Fiscal Year 1989.

Species	No. Processed	Percentage
Antelope (*Antilocapra americana*)	1	00.6
Bald Eagle (*Haliaeetus leucocephalus*)	9	05.2
Beaver (*Castor canadensis*)	4	02.2
Bighorn Sheep	16	09.2
Black Bear	46	26.3
Bobcat	8	04.5
Bison	3	01.7
Coyote (*Canis latrans*)	1	00.6
Elk	2	01.1
Fisher (*Martes pennanti*)	1	00.6
Golden Eagle (*Aquilla chrysaëtos*)	4	02.3
Great Grey Owl (*Strix nebulosa*)	1	00.6
Grizzly Bear	7	04.1
Loon (*Gavia immer*)	1	00.6
Moose (*Alces alces*)	1	00.6
Mountain Lion	33	19.0
Mule Deer (*Odocoileus hemionus*)	12	06.9
Otter (*Lutra canadensis*)	3	01.7
Pelican (*Pelecanus erythrorhynchos*)	1	00.6
Pine Marten	2	01.1
Prairie Falcon (*Falco mexicanus*)	1	00.6
Rough Legged Hawk (*Buteo lagopus*)	1	00.6
White-tailed Deer (*Hemionus virginianus*)	8	02.8
Wolf	3	01.7
Wolverine (*Gulo gulo*)	5	02.9

possible wolf scat from the Bitterroot and 16 winter scats collected adjacent to wolf tracks along the Rocky Mountain East Front.

The scat from the Bitterroot and three of those from Ninemile Creek were determined to be bear scats while one of those from the East Front appeared to be a coyote scat.

Because of the small sample size, results of the examination of East Front scats will not be presented. Results of analysis of Ninemile Creek scats are briefly summarized in Table 2.

Table 2. Late winter-early summer 1990 food habits of wolves in the Ninemile Creek vicinity as determined from analysis of scat contents. Figures are percent frequency of occurrence/percent of total volume. Tr denotes items comprising less than 0.5% frequency of occurrence or 0.05% of total volume.

Food Item	Total Scats (N = 284)
Deer fawn/elk calf	70/62.2
Moose calf	Tr/0.1
Adult Deer (both species)	19/17.8
Adult Elk	7/8.1
Unidentified Adult Cervid	1/0.1
TOTAL CERVID	95/88.1<
Cattle (*Bos taurus*)	6/7.3
TOTAL LIVESTOCK	6/7.3
TOTAL LARGE MAMMAL	98/95.4
Canids	5/1.5
Felids	4/0.7
Sciurids	2/0.3
Lagomorph	5/1.3
Miscellaneous Mammal	1/0.9
Bird	1/Tr
Green grass	9/0.1
TOTAL OTHER ITEMS	24/4.6
Total Scat Volume (ml.)	15,440

Nutrition

Blood samples were obtained from 383 elk, 152 white-tailed deer, 142 mule deer, 60 bighorn sheep, 37 moose, 7 black bear, 1 grizzly bear, and 14 bison. Serum biochemistries were run on most of these samples to explore the possibility of using some of the parameters as an index to animal or herd condition. Test results were returned to the projects which submitted the samples and one copy retained in our files to be entered into a master computer database maintained at the laboratory. The data available in this master file will allow comparisons of herd condition between years and herd groups.

A database was created to compile information on blood biochemistries and hematology. The database format was completed and a data entry screen completed. The process of data entry will continue through the next year.

Animal Reproduction

Reproductive tracts were collected from various wildlife processed through the laboratory including otter, bear, lion, wolf, bobcat, fisher, and marten. Tracts are fixed and later examined to count corpora lutea and placental scars. During the report period, 1 grizzly bear, 1 wolf, 200 adult pine marten, and 100 juvenile pine marten tracts were examined. Results from the examination of pine marten reproductive tracts are summarized in the pine marten study section of this report. A summary of results from the examination of 44 grizzly bear tracts was completed for inclusion in a paper to be presented on the reproductive performance of female grizzly bears (Appendix A).

Serum samples from 134 elk and 2 moose were submitted for pregnancy determinations based on radioimmunoassays for pregnancy-specific protein B (PSPB). This technique has proven reliable in detecting pregnancy in domestic cattle (*Bos taurus*) and sheep (*Ovis aries*) as well as in free-ranging mule and white-tailed deer (Wood et al. 1986).

To confirm the accuracy of PSPB assays in elk, serum samples and female reproductive tracts were solicited from hunters participating in the post-season antlerless elk hunt on the Flying D Ranch in Gallatin Canyon. Sixty-three females from which both a fetus and an adequate blood sample were received were all correctly called pregnant by PSPB. Fifteen male calves were all called open by this technique. Based on these and previous results, pregnancy status of elk determined by PSPB appears highly accurate (98% or more). Both moose samples submitted for PSPB analysis were apparently correctly determined by PSPB.

Age Determinations

During the report period, 436 teeth were submitted to Matson's Laboratory for counts of cementum annuli. Three hundred forty-four marten teeth were x-rayed to classify juveniles from adults. Results from the determinations were filed and distributed to various programs. Results of cementum counts were compared to other aging techniques when possible.

Tests were conducted on the aging of mountain lion using cementum annuli in the premolar tooth and aging pine martens with x-rays and cementum annuli. Results are presented in Pine Marten Studies and Mountain Lion Studies sections of this report.

Pine Marten Studies

Food Habits

Marten food habits from statewide collections made in 1989-90 are compared in Tables 3 and 4. These findings will not be discussed in detail at this time. However, several generalizations can be made. In both years and all areas, mice ("small" rodent category) were the primary prey with microtines forming the bulk of the identifiable remains. There appeared to be more variety in the winter diets of pine marten in Regions 2 and 3 than in Region 1. There are considerable habitat differences between these areas which may explain the difference.

Cervid carcasses are often used as draw stations by trappers, and cervid remains, red squirrel (*Tamiasciurus hudsonicus*), muskrat (*Ondatra zibethicus*), and beaver are often used as bait. An unknown percentage of these items was undoubtedly bait, but if any doubt existed as to their source, these items were included as food.

Vegetation became an important dietary component in Region 3 and a minor item in Region 2 during 1989-90. This consisted almost entirely of whitebark pine (*Pinus albicaulis*) nuts, and followed the highest average whitebark pine cone production year in the Yellowstone Park area since transects were established in 1980 (Knight et al. 1990).

Results of analysis of contents of marten stomachs and colons collected in Region 3, 1988-89, indicated a high proportion of microtus in the winter diet (Table 5). Pine martens were not found in diets of pine marten in Region 3 during the winter of 1988-89.

Pine Marten Reproduction

Pine marten tracts have been examined for collections made during the period 1985-1990. Tracts from the 1990-91 season are fixed and prepared for examination. During the period 1985-1990, 290 female tracts were collected from carcasses. Two hundred thirty-seven were in sufficient condition for a thorough examination. Corpora lutea were counted in 65.4% of those examined. Pregnancy as determined by corpora lutea increased with age (Table 6). One juvenile carcass was found to contain corpora lutea during the examination. This particular specimen was aged by premolar counts of cementum annuli. In addition, the tract had juvenile characteristics. However, it is interpreted that this specimen was actually one year old.

There was no difference between the number of corpora lutea in the right versus the left ovary ($P<0.05$). The number of corpora lutea in all pregnant pine marten ranged from 1 to 4, and the mean was 2.46. This is considerably lower than the mean recorded by Strickland and Douglas (1987) for the Algonquin region of Canada. Wright (1963) reported a mean of 3.02 corpora lutea per pregnant female for Montana. The

Table 3. Winter 1989-90 food habits of Montana pine marten as determined from examination of stomach contents. Figures are percent frequency of occurrence/percent of total diet; Tr denotes items comprising less than 0.5% frequency of occurrence or 0.05% off the total diet.

FOOD ITEM	Region 1 (N = 52)	Region 2 (N = 87)	Region 3 (N = 79)	TOTAL (N = 223)[1]
Livestock	-/-	1/1.1	1/1.0	1/0.8
Cervid	29/23.7	23/12.0	22/14.5	24/15.3
Unid. large mammal	2/1.9	1/1.0	8/3.4	4/2.0
TOTAL LARGE MAMMAL	31/25.6	25/14.1	30/18.9	28/18.2
Pocket Gopher (*Thomomys umbrinus*)	-/-	1/1.1	-/-	Tr/0.4
Flying Squirrel (*Glaucomys sabrinus*)	-/-	5/4.6	4/3.0	3/2.9
Red Squirrel	4/2.0	8/7.3	4/1.9	5/4.0
Woodrat (*Neotoma cinerea*)	-/-	2/2.3	3/2.5	2/1.8
Porcupine (*Erethizon dorsatum*)	-/-	-/-	1/Tr	Tr/Tr
Muskrat	-/-	9/8.7	-/-	4/3.4
Beaver	4/3.8	1/1.1	1/0.3	2/1.4
TOTAL "LARGE" RODENT	8/5.8	26/25.2	13/7.7	16/3.9
Microtus	-/-	10/7.8	11/6.9	8/5.5
Clethrionomys	21/18.2	9/6.1	5/4.8	10/8.4
Unid. Microtine	4/3.8	6/5.7	-/-	3/3.1
Peromyscus	2/1.5	1/0.5	8/6.4	4/2.8
Unid. Mouse	27/20.4	28/23.8	28/17.1	28/21.0
TOTAL "SMALL" RODENT	54/44.1	53/44.0	51/35.3	52/40.8
LAGOMORPH	12/7.3	8/5.7	9/3.4	10/6.0
BIRD	15/6.2	8/7.0	18/7.9	13/7.4
VEGETATION	-/-	2/0.2	37/22.4	14/8.0
MISCELLANEOUS	13/11.0	6/3.8	10/4.5	9/5.7

[1] Includes two samples from Region 5 and three from unknown regions.

Table 4. Winter 1989-90 food habits of Montana pine marten as determined from examination of colon contents. Figures are percent frequency of occurrence/percent of total diet; Tr denotes items comprising less than 0.5% frequency of occurrence or 0.05% of the total diet.

FOOD ITEM	Region 1 (N = 54)	Region 2 (N = 95)	Region 3 (N = 76)	TOTAL (N = 236)[1]
Livestock	-/-	6/6.3	1/1.1	3/2.9
Cervid	26/24.1	15/12.8	14/4.4	17/12.5
Unid. Large Mammal	4/3.7	2/2.1	1/1.3	2/2.1
TOTAL LARGE MAMMAL	30/27.8	23/21.2	17/6.8	22/17.5
Pocket Gopher	-/-	-/-	-/-	-/-
Flying Squirrel	-/-	2/1.2	4/3.9	2/1.7
Red Squirrel	6/5.5	7/6.3	8/5.3	7/5.5
Woodrat	-/-	1/1.1	-/-	Tr/0.4
Porcupine	-/-	-/-	1/1.2	Tr/0.4
Muskrat	-/-	5/5.3	3/1.4	3/2.6
Beaver	2/1.8	3/2.2	5/5.3	4/3.8
TOTAL "LARGE" RODENT	7/7.3	19/15.9	21/17.1	17/14.5
Microtus	-/-	-/-	7/5.2	2/1.7
Clethrionomys	-/-	-/-	-/-	-/-
Unid. Microtine	9/9.3	8/8.3	3/1.1	6/5.8
Peromyscus	-/-	-/-	-/-	-/-
Unid. Mouse	44/38.6	38/32.7	33/22.6	38/31.4
TOTAL "SMALL" RODENT	54/47.9	46/41.0	42/28.9	47/38.9
LAGOMORPH	7/7.4	5/5.3	11/5.0	8/5.9
BIRD	7/5.4	11/6.1	5/3.7	8/4.9
VEGETATION	-/-	3/2.1	41/27.5	15/9.7
MISCELLANEOUS	7/4.2	8/8.3	16/11.0	11/8.7

[1] Total includes four samples from Region 5 and seven from unknown Regions.

Table 5. Winter 1988-89 food habits of marten in Fish, Wildlife and Parks Region 3 as determined from examination of stomach and colon contents. Figures are percent frequency of occurrence/percent of total diet; Tr denotes items comprising less than 0.5 percent frequency of occurrence or 0.05 percent of the total diet.

Food Item	Stomachs (N = 131)	Colons (N = 112)	Total (N = 243)
Livestock	2/2.2	1/0.9	2/1.6
Cervid	19/10.0	6/1.9	13/6.3
Unid. Large Mammal	1/0.7	-/-	Tr/0.4
TOTAL LARGE MAMMAL	22/13.0	7/2.8	15/8.3
Pocket Gopher	2/1.5	-/-	1/0.8
Flying Squirrel	2/1.8	2/1.7	2/1.7
Red Squirrel	9/7.8	9/8.3	9/8.0
Woodrat	1/0.8	-/-	Tr/0.4
Muskrat	2/1.5	1/0.9	1/1.2
Beaver	1/0.8	4/3.7	2/2.1
TOTAL "LARGE" RODENT	16/14.2	16/14.6	16/14.4
Microtus	34/29.1	29/27.3	31/28.2
Clethrionomys	8/7.0	2/1.8	5/4.6
Unid. Microtine	2/2.3	-/-	1/1.2
Peromyscus	9/7.3	4/3.1	7/5.4
Zapus	2/1.5	-/-	1/0.8
Unid. Mouse	16/10.2	29/28.7	22/18.7
TOTAL "SMALL" RODENT	69/57.4	63/60.8	67/59.0
LAGOMORPH	7/5.4	5/5.3	6/5.4
BIRD	13/5.7	12/7.9	13/6.7
VEGETATION	-/-	-/-	-/-
MISCELLANEOUS	11/4.4	20/8.6	15/6.3

Table 6. Pregnancy rates and corpora lutea counts of various age classes of pine marten in Montana, 1985-1990.

Age	Pregnancy Rate	Mean Number of Corpora Lutea	95% Confidence Interval ANOVA
Juv.	0.029	0.029	0.00-0.22
1	0.873	1.94	1.76-2.13
2	0.888	2.18	1.95-2.42
3	1.000	2.79	2.36-3.20
4	0.888	2.44	1.92-2.96
5+	0.955	2.55	1.54-3.56

reproductive performance of yearlings and two-year old martens was only slightly lower but not significantly lower than that of older marten.

During examination of reproductive tracts, several physical characteristics of reproductive tracts were measured. Analysis indicated that juvenile reproductive tracts were significantly different from yearling and older pine martens (Table 7). Ovaries from juveniles were significantly lighter, and the uterine horns were shorter ($P<0.05$). Uterine horns of yearlings were slightly shorter, but ovary weights were comparable to older marten. Female reproductive tracts attained a fully mature appearance by age two.

Table 7. The physical characteristics of female reproductive tracts in Montana pine marten.

Age	N	Mean Length Uterine Horn Right (mm)	Mean Length Left Placenta (mm)	Mean Wt. Right Ovary (gm)	Mean Wt. Left Ovary (gm)
Juv	73	29.78	28.73	0.008	0.009
1	72	40.51	39.75	0.014	0.015
2	44	46.79	46.32	0.015	0.016
3	13	48.69	46.92	0.018	0.018
4	10	50.80	49.80	0.015	0.016
5+	20	45.55	47.65	0.015	0.015

Age and Sex Determinations of Pine Martens

The proportion of pulp cavity to tooth diameter was used to differentiate juvenile and adult teeth following radiography. The percent pulp cavity in juvenile teeth was greater than 34.4 ($P<0.01$) (Table 8). The mean proportion of pulp cavity to tooth

Table 8. The mean proportion of pulp cavity and 99% confidence interval for various age classes of pine marten.

Age	N	Mean Proportion	99% Confidence Interval of Mean
Juv	239	38.59	34.41-42.77
1	96	27.20	20.60-33.81
2	39	18.30	7.94-28.65
3	21	16.49	2.38-30.60
4	13	15.94	0.00-33.87
5	7	15.25	0.00-39.69
6	4	12.16	0.00-44.50
7	3	7.12	0.00-49.79
8	2	4.06	0.00-43.81

diameter decreased with age. Sample size was small in the older age classes creating broad confidence intervals. However, for ages juvenile compared to yearling through. years of age, the difference between proportions was significant enough to allow us to determine juveniles accurately.

Baculum measurements were made on all male carcasses. The mean baculum length of juveniles was significantly lower than for older age classes (Table 9). Baculum lengths less than 35 mm were indicative of juvenile male martens. Baculum lengths increased quickly and attained adult length by age one.

Table 9. Baculum lengths of male pine marten in Montana.

Age	N	Mean Baculum Length (mm)	99% Confidence Interval
Juv	321	33.6	33.1-34.0
1	157	38.5	37.7-39.2
2	62	37.8	36.7-38.9
3	35	37.3	37.3-40.3
4	10	39.1	36.3-41.8
5	12	39.0	36.4-41.5
6	8	38.6	35.5-41.7
7	6	39.2	35.6-42.7
8	4	39.0	34.7-43.4
0	4	38.8	34.4-43.1

The mean weight of female carcasses was significantly less than the weight of male carcasses (Table 10). Considerable variation existed in the skinning and care of carcasses before they were received in the laboratory. Many carcasses were dehydrated and necrotic, thereby affecting the skinned carcass weight. There did seem to be a increasing trend in carcass weight with age, and some distinction in adult and juvenile carcasses was evident (Table 10). However, there was considerable overlap in the 95% confidence intervals for several age classes for this measurement.

Table 10. The mean skinned weight for various age and sex classes of pine marten in Montana.

Age	N	Mean Weight Males (gms)	95% Confidence Interval	N	Mean Weight Females (gms)	95% Confidence Interval
Juv	470	718.0	705.3-730.8	348	505.1	494.6-515.5
1	204	779.7	760.4-799.0	139	535.1	518.6-551.6
2	92	750.8	722.0-779.5	71	521.9	498.8-545.1
3	40	823.1	779.5-866.7	30	550.9	515.4-586.5
4	15	805.2	734.0-876.4	15	521.3	471.0-571.6
5	13	875.7	799.2-952.2	7	573.4	499.8-647.1
All Age	863	747.7	738.3-757.1	631	517.8	510.0-525.5

Age and Sex Composition

The collection of carcasses during 1989 and 1990 was conducted on a statewide basis. The mean age of the statewide collection was 1.39 in 1989 and 1.30 for 1990. There was no significant difference ($P < 0.05$) in the mean between years. The female:male ratio was 42:58 in 1989 and 41:59 in 1990.

The age and sex ratios examined by MDFWP Region compared the two years of collection. Sex ratios were constant between years and regions with the minor exception of Region 2 in 1990 (Figs. 1 and 2). During 1990, the Region 2 carcass collection was significantly reduced from the previous year, and differences may not be representative of any change in the sex composition of the harvest.

The mean age of martens collected by Regions 1, 2, and 3 has varied slightly (Figs. 3 and 4). The mean age did not change significantly in Regions 1 and 2, but was considerably lower in Region 3. The age distribution by region indicates considerable change in Regions 2 and 3, while in Region 1 it remained stable (Figs. 5 and 6). A considerable increase in the percentage of juveniles was noted in both Regions 2 and 3 in 1990-91.

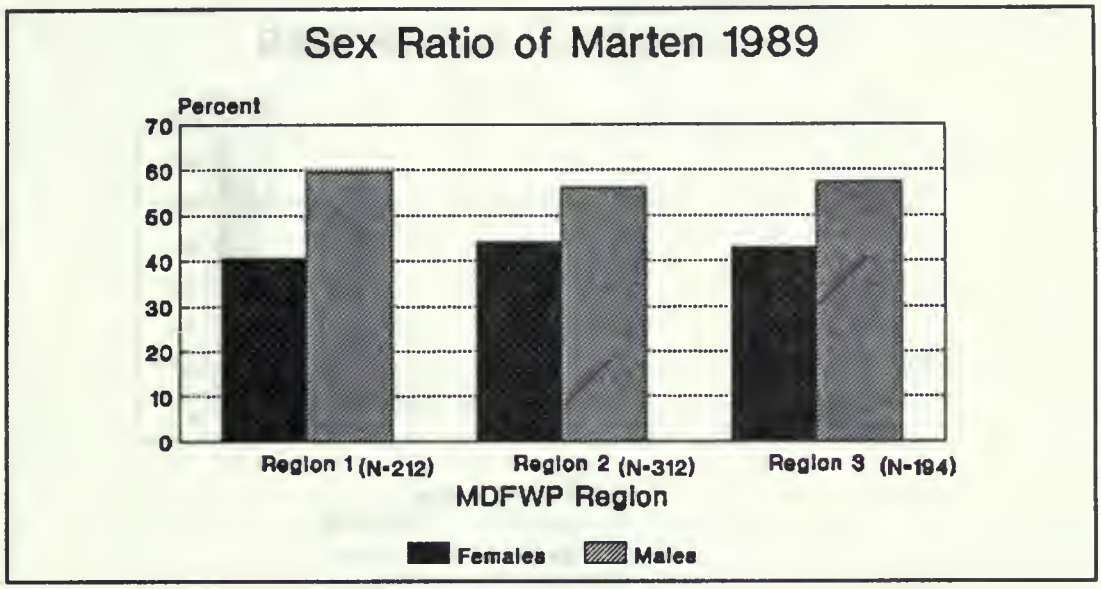


Figure 1. The sex ratio of marten carcasses collected in Montana during the 1989-90 trapping season.

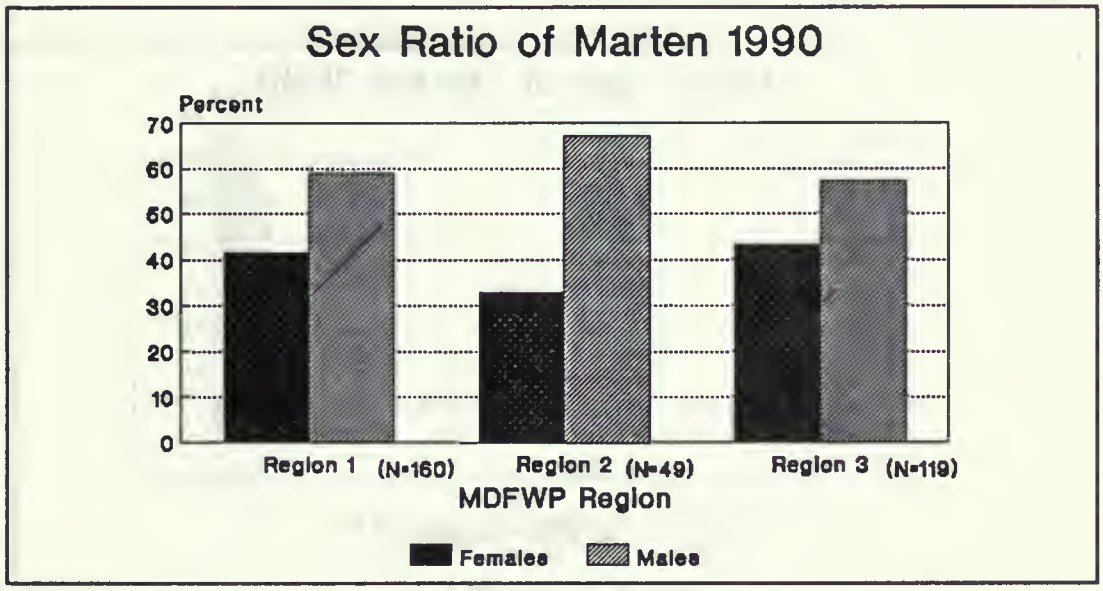


Figure 2. The sex ratio of marten carcasses collected in Montana during the 1990-91 trapping season.

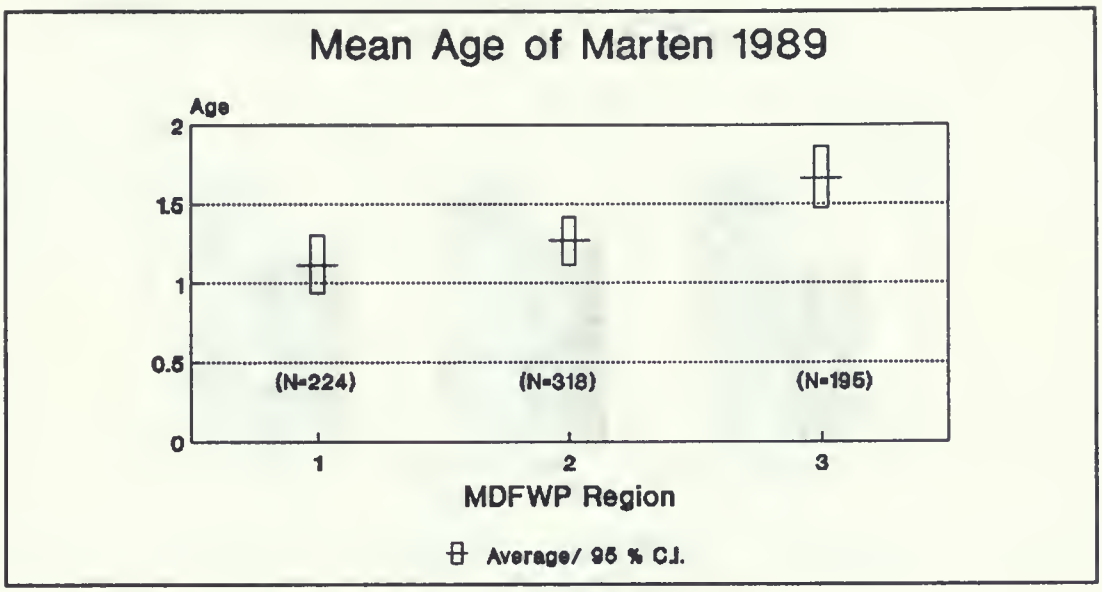


Figure 3. The mean age of marten carcasses collected in Montana during the 1989-90 trapping season.

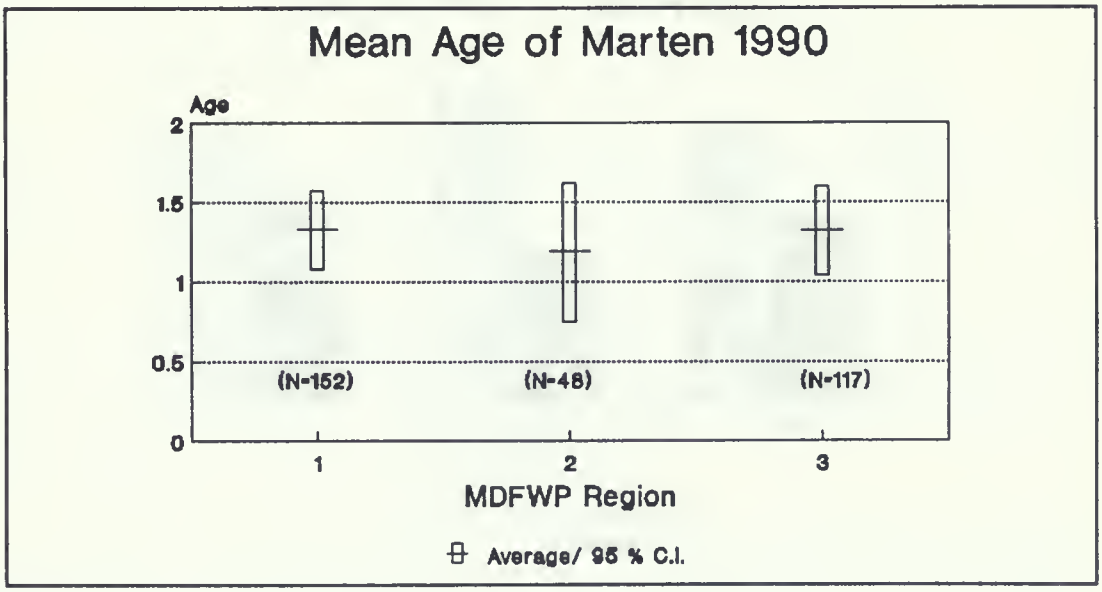


Figure 4. The mean age of marten carcasses collected in Montana during the 1990-91 trapping season

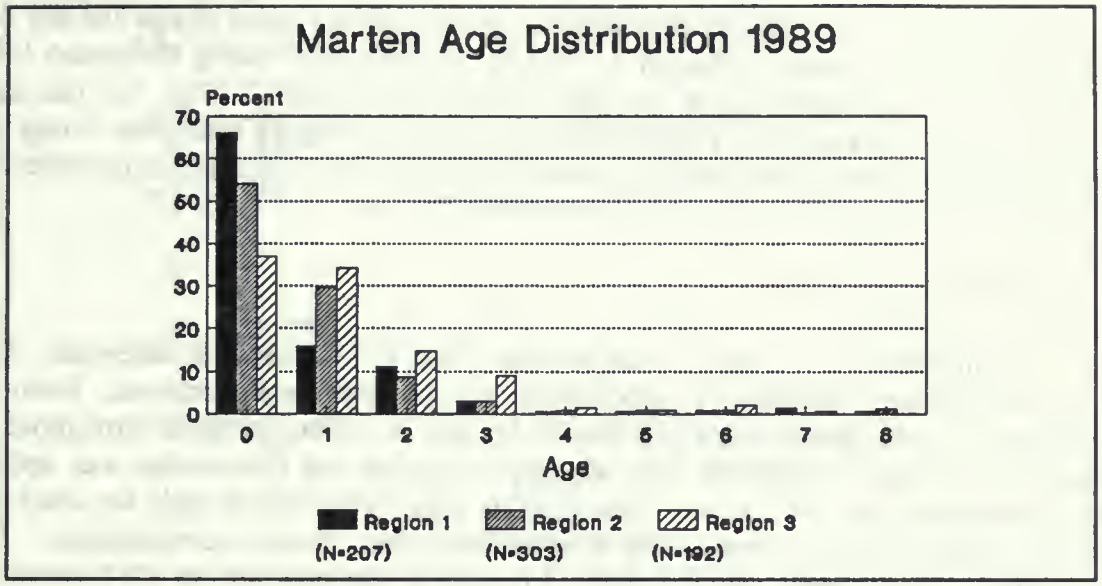


Figure 5. The age distribution of pine marten for each MDFWP region in Montana during the 1989-90 trapping season.

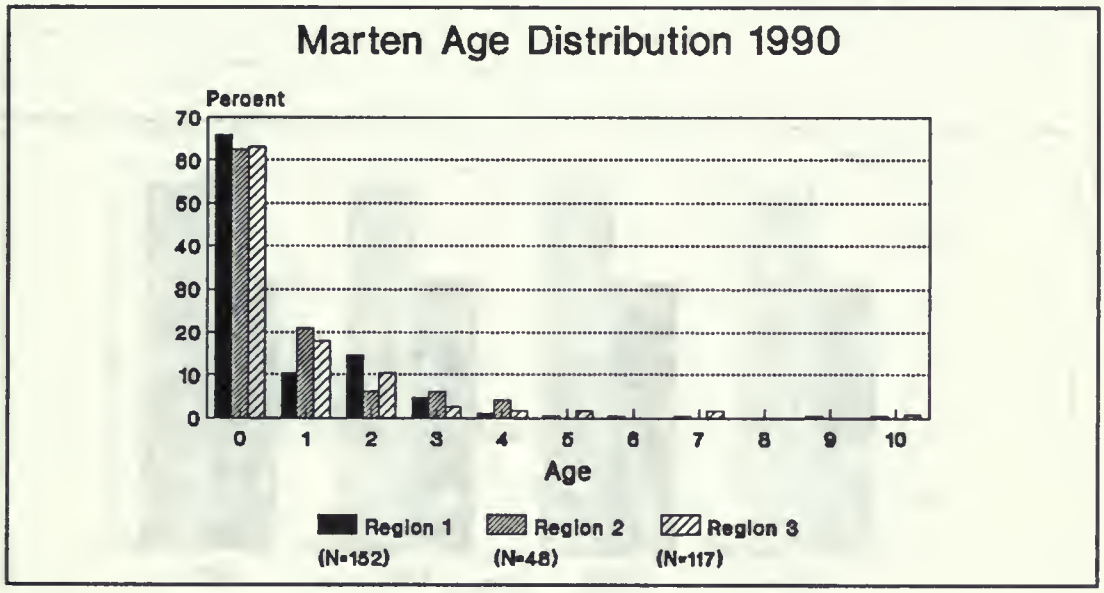


Figure 6. The age distribution of pine marten for each MDFWP region in Montana during the 1990-91 trapping season.

The pine marten carcass collection has generated four years of age and sex data for harvested pine marten in Region 3. The female:male ratio during the period 1987-1990 has remained stable with a four year total ratio of 42.8:57.2 (Fig. 7). The mean age of marten collected during 1987-1990 has decreased slightly each year during this period (Fig. 8). The age distribution has been dynamic with the number of juveniles and one year old martens fluctuating over the period (Fig. 9).

Animal Immobilizations

Immobilizing drug needs were solicited from FWP personnel statewide. New supplies of Telazol, Ketamine Hydrochloride, and Rompun were purchased. Ketamine and Rompun were freeze dried and bottled for use in various projects throughout the state. The computer database with all drug purchases and distribution was updated during the report period. A new chest girth to weight relationship table for bears was built to assist projects in estimating weights for proper dosage administration. The Department DEA permit was renewed. Consulting was provided to FWP personnel during various immobilization situations throughout the state. A bear handling and immobilization seminar was attended in Yellowstone National Park. Additional equipment purchases were made to upgrade the laboratory tranquilizing equipment. A fire proof file cabinet was purchased for security storage of important records. Outdated drug stocks were incinerated.

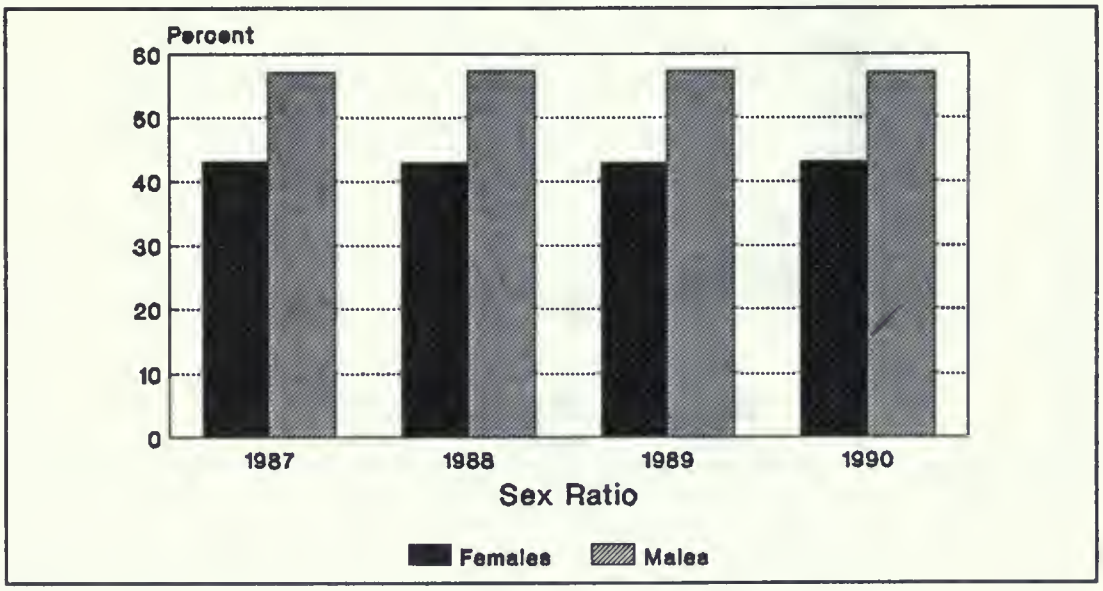


Figure 7. The sex ratio of marten collected from Region 3, 1987-1990.

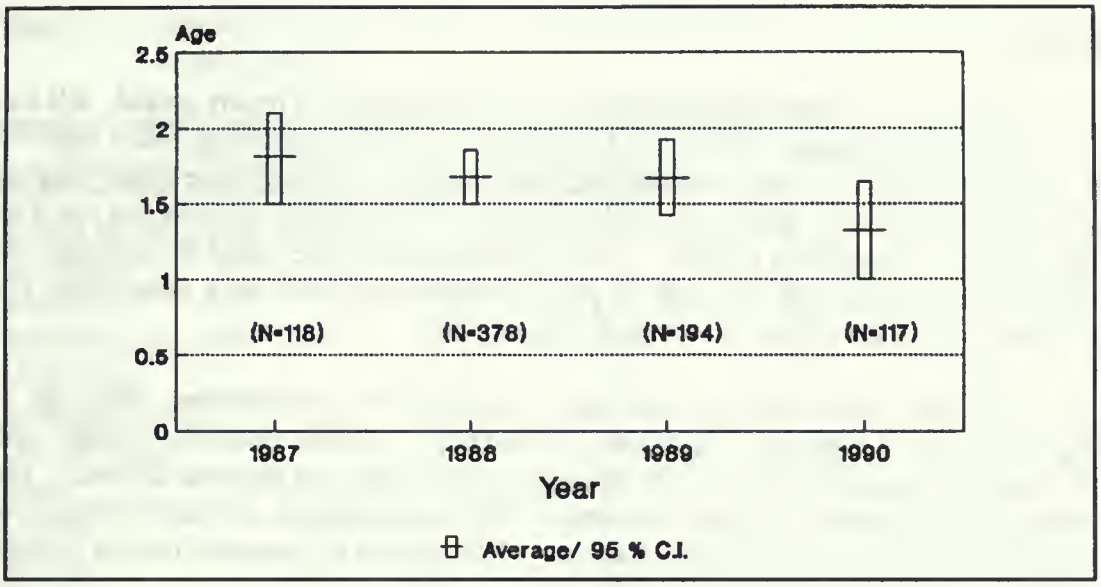


Figure 8. The mean age of marten collected from Region 3, 1987-1990.

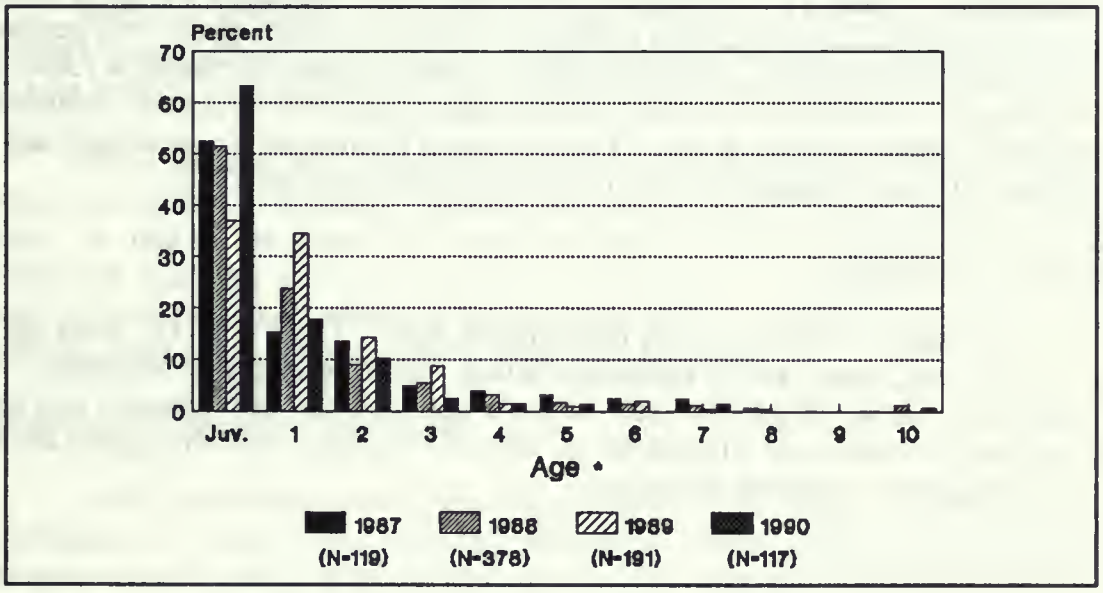


Figure 9. The age distribution of marten collected from Region 3, 1987-1990.

Bison Studies

Eleven bison were taken by Montana hunters during the report period. All eleven bison were males ranging from 4 to 14 years of age. Three additional bison were killed during management actions, and one was road killed. All were male bison ranging in age from 3 to 5 years. Blood was collected from all hunter-killed bison and the 3 bison killed during management controls. Three female bison were killed for scientific study within Yellowstone National Park by park biologists and their ages determined at our laboratory. The three females were all 3-year olds.

A tissue collection process was established in coordination with the State Department of Livestock, Diagnostic Laboratory. When possible, lymph nodes, reproductive organs, and blood will be collected to culture for *Brucella abortus*. Tissue from one bison killed during management in 1991 was collected, and culture results were negative as was the test from blood serum. Further work is planned on this portion of the study in the coming fall and winter.

Animal Necropsies

A total of 53 specimens representing 13 species of birds and mammals were necropsied to determine the cause of death or to identify tissues, parasites, or abnormalities (Table 11). Thirty-one necropsies were conducted by the Veterinary Pathologists at the State Diagnostic Laboratory. Twenty-two necropsies were performed at the MDFWP Laboratory. Necropsy reports were filed and distributed to requestors. Two forensic examinations were conducted on bears, and 20 bone marrow compression tests were conducted on mule deer. Four grosbeaks (*Hesperiphona vespertina*) and two sparrows (*Passer domesticus*) were submitted for toxicology tests.

Annual Trophy Sale

The annual trophy sale was conducted in April. There were 113 items for sale including hides, capes, skulls, claws, and antlers from nine species of mammals. Parts from bighorn sheep, black bear, and mountain lion were the most common sale items. Gross sale proceeds were $19,746.00 A total of 75 bidders from throughout the U.S. and Canada were registered at the sale.

Educational Materials

The wildlife mounts and reference specimens for the local wildlife educational programs were available at the Wildlife Laboratory throughout the year. Specimens were checked out by educators routinely during the report period. Several specimens were loaned to other agencies and institutions who are engaged in wildlife education programs.

Table 11. Species and frequencies of wildlife specimens submitted for necropsy during FY 90.

Necropsy Type/Species	Frequency	Percent
Edible Meat/Tissue Exams	7	13.2
Grosbeaks	4	7.5
Antelope	1	1.9
White-tailed Deer	2	3.8
Mule Deer	13	24.5
Mountain Lion	7	13.2
Grizzly Bear	3	5.7
Wolf	4	7.5
Coyote	3	5.7
Bobcat	2	3.8
Fisher	1	1.9
Black Bear	2	3.8
Eagle	2	3.8
Sparrows	2	3.8

Several educational and display materials were prepared during the year. These include a mounted bald eagle and pine marten; a tanned moose hide; a tanned elk hide; six bear boards; three grizzly head mounts; and several tanned bear and lion hides.

Thirty requests for specimens from our hide and skeletal reference collections were received during the year. Eighteen requests were filled, and five were partially filled. A total of ten tanned hides and two green hides were distributed to various institutions, agencies, and museums throughout the U. S. In addition, over 50 skulls from various mammals were distributed to requestors. Requests for jawboards, skeletons, bear claws, antlers, and elk teeth were also filled.

Biotelemetry Frequency Coordination

In 1989, all known users of wildlife biotelemetry in the State of Montana provided information on wildlife transmitters they operated in various programs. The data from this census was entered into a computer in 1990. A survey was conducted in July 1990 to update the information on the computer database. Updates to the data were made throughout the year as information was received from projects. A new thorough update is in progress.

Frequencies ranged from 148.000 to 171.000 for wildlife telemetry devices. The most commonly used range was 150.000 to 152.000 (Table 12). Approximately 1,200

Table 12. Distribution of radio frequencies used on wildlife telemetry devices, 1990-91.

Frequency Range	No. Transmitters	Percentage
148.000-149.000	102	4.5
150.000-150.500	344	15.2
150.500-151.500	920	40.6
151.500-152.500	417	18.4
152.500-153.000	47	2.1
164.000-164.500	124	5.5
164.500-165.500	219	9.7
165.500-166.500	82	3.6
166.500-167.500	10	0.4
171.000-172.000	1	0.1
	2,266	100.0

of the listed telemetry devices were operating on wildlife through the report period. The remainder were on order, in storage, or being rebuilt. Telemetry devices operated on 20 species of wildlife (Table 13). Elk, mule deer, white-tailed deer, moose, and grizzly bears were the most common species radio collared.

Ten agencies or institutions have participated in the radio telemetry coordination program in 1990-91 (Table 14). The MDFWP was the agency most commonly employing biotelemetry in their programs.

Parasites of Wildlife

Trichinella tests were completed on 13 black bears, 95 mountain lions, and 1 bobcat, most of which were submitted by hunters. In addition, samples from 47 marten from the 1990-91 trapping season were examined for this parasite as a special project conducted by a parasitology student. The bobcat and all black bears tested negative for trichinella, while 34 (36%) of the mountain lions were positive at levels of 0.04 to 21.9 larvae per gram (LPG) of tissue sampled. Ten of the 47 (21%) marten sampled had trichinella present at levels of 0.04 to 134.2 LPG.

One or more species of helminth parasites were found in the gastrointestinal tract of all animals examined. These included two wolves, one black bear, one bobcat, one mule deer, and one mountain lion. In addition, the mule deer had several ticks (*Dermacentor spp.*) and bots (*Cephenemyia spp.*) present, while cysts of *Taenia krabbei* were present in muscle tissue of a second mule deer submitted by a hunter. Because of the small number of animals involved, these results will not be discussed further.

Table 13. Biotelemetry devices ordered and operating on wildlife species in and near Montana, 1990-91.

Species	No. Devices	Percent
Elk	902	44.5
Deer (WT and MD)	424	20.9
Moose	53	2.6
Grizzly Bear	299	14.7
Black Bear	38	1.8
River Otter	6	0.3
Bald Eagle	19	0.9
Mountain Goat	6	0.3
Bighorn Sheep	22	1.1
Wolf	34	1.7
Golden Eagle	3	0.1
Caribou	28	1.3
Fisher	52	2.5
Sharptailed Grouse	45	2.2
Turkey	71	3.5
Boreal Owl	2	0.1
Sage Grouse	7	0.3
Hawks	12	0.6
Mountain Lion	3	0.1
Total	2026	100.0

Table 14. The number of biotelemetry devices used in various wildlife programs throughout and near the State of Montana, 1990-91.

Wildlife Agency	No. of Devices	Percent
The Blackfoot Nation	13	0.6
U. S. Forest Service*	19	0.8
Mont. Dept. FWP	1533	67.6
U.S. Fish and Wildlife Serv.	144	6.4
Glacier Natl. Park	26	1.1
Idaho Fish and Game	45	2.0
Interagency Grizzly Study	120	5.3
Montana State University	126	5.6
University of Montana	204	9.0
Wildlife Wildlands Inst.	5	0.2
Other or Unknown	31	13.6

* Includes radio frequency for hand radios.

White-tailed deer heads were collected statewide for examination to determine the occurrence of the meningeal worm *Paraelaphostrongylis tenuis*. Approximately 50 deer heads have been collected and frozen for examination this winter in cooperations with the parasitology lab in the Veterinary Molecular Biology Lab. This collection and examination process will continue for the next several years.

An abstract on the parasites of mountain lions was submitted to the Montana Academy of Sciences (Appendix B). The authors included MDFWP laboratory assistant Tim Weiss, Dr. Floyd Seesee, and Dr. David Worley. The work was cooperatively conducted by the Veterinary Molecular Biology laboratory and the MDFWP wildlife laboratory over the past few years.

Work is continuing on a paper to submit to the Journal of Wildlife Diseases (Appendix C) co-authored by Keith Aune, Dr. Floyd Seesee, and Dr. Dave Worley. The work includes summaries of the results from 20 years of trichinella studies on bears in Montana. Analysis is completed, and the manuscript is being drafted.

Computer databases were created for trichinella results from grizzly bear, black bear, and mountain lion. Data included over 900 records from lions, 300 from grizzly bear, and about 500 from black bear. Analysis will be conducted for inclusion in professional papers in the near future.

Diseases of Wildlife

The Montana Veterinary Diagnostic Laboratory tested 807 individuals of 28 species (20 wildlife and 8 domestic livestock or pets) for rabies during the report period. Positive test results were obtained from 2 of 49 cattle, 13 of 13 bats, and 19 of 89 skunks. All remaining individuals from 25 species tested negative for rabies.

Blood serum samples from several species of wildlife were tested by the Diagnostic Laboratory for the presence of antibodies against anaplasmosis, bluetongue, brucellosis, and leptospirosis. Additional diseases tested for in three bison included infectious bovine rhinotracheitis (IBR), bovine virus diarrhea (BVD), and parainfluenza 3 (PI-3). Results from these additional tests will provide baseline data for comparison with data collected in subsequent years.

Wildlife samples tested for anaplasmosis included 381 elk, 138 mule deer, 35 white-tailed deer, 37 moose, 60 bighorn sheep, and 3 bison. Positive results were obtained from eight bighorn and one mule deer; all other anaplasmosis tests were negative.

Bluetongue was diagnosed in a single mule deer. All other animals (381 elk, 137 mule deer, 35 white-tailed deer, 37 moose, 60 bighorn sheep, and 3 bison) tested negative for bluetongue antibodies.

Samples tested for brucellosis included 381 elk, 138 mule deer, 35 white-tailed deer, 37 moose, 60 bighorn sheep, 7 black bear, 2 grizzly bear, and 14 bison. Five of 14 bison bulls killed near West Yellowstone and 1 elk from the lower Gallatin tested positive. Two additional lower Gallatin elk gave suspect reactions. One grizzly bear was tested positive, and a second was test conducted. The subsequent test also indicated a positive reactor. All remaining results were negative.

Positive leptospirosis tests included 42 of 381 elk, 4 of 138 mule deer, 7 of 35 white-tailed deer, 5 of 37 moose, 4 of 60 bighorn sheep, 0 of 7 black bear, 1 of 2 grizzly bear, and three of three bison.

All three bison tested were positive for both BVD and PI-3, and one of the three was positive for IBR.

Two mule deer were collected at a Corwin Springs game farm where elk have tested positive for tuberculosis (TB). These specimens, plus lymph nodes attached to 22 sets of lungs obtained from hunter-killed elk in the same area, were examined at the Diagnostic Lab for evidence of TB. None of the samples showed lesions typically associated with TB, although one elk had lymph node lesions suggestive of a bacterial infection.

In addition to the disease tests noted above, one coyote was diagnosed with canine distemper, and a poisoning incident involving one coyote and two bald eagles (one adult and one subadult) was investigated. The carbamate insecticide aldicarb was found in the stomach of the coyote; strychnine and cyanide were not detected. The eagles were submitted to the National Wildlife Health Research Center for necropsy and further analysis. These results had not been received by the end of the report period.

A computer database was completed with entries from serological surveys conducted throughout the State of Montana. The database includes over 4,000 records from many species including deer, sheep, elk, moose, bear, and lion. The file editing and clean up is nearly complete. This data will be updated annually allowing further analysis of serological survey results.

Grizzly and Black Bear Studies

Morphology Study

Two databases were created to examine the morphology of grizzly and black bears in Montana. The mortality database includes all known deaths and results from examination of the carcasses. This database is complete with records from over 500 black bears and 700 grizzly bears. The black bear capture database includes data from over 800 black bears handled during research throughout the State of Montana. The

grizzly bear capture database includes records of 260 grizzly bears handled in the northwestern portion of Montana.

Skulls of both black and grizzly bears are being examined to assist in the determination of sex from unknown specimens and determine dimorphism (Table 15). Preliminary data shows that skull length of black bears becomes dimorphic by age 3, and skull measurements would be one method of properly sexing an unknown specimen. Grizzly bears skull length and width are clearly dimorphic by age 4, and sex can be determined accurately for these older specimens.

Table 15. Dimorphic characteristics in black and grizzly bear skulls.

Species/Sex	N	Length (mm)	Confidence Interval	Width (mm)	Confidence Interval
Black Bear Female[1]	66	251.0	247.4-254.6	147.5	145.6-149.3
Black Bear Male	172	280.6	278.2-283.0	164.9	162.7-167.1
Grizzly Bear Female[2]	140	318.5	312.9-323.9	179.3	172.2-186.4
Grizzly Bear Male	149	356.1	350.5-360.7	198.1	190.5-205.7

[1]95% confidence interval-includes all ages
[2]99 % confidence interval-includes only bears 4 and older

Nuisance Bear and Relocation Study

In the Northern Continental Divide (NCDE) and Yellowstone Ecosystems, records of relocations were compiled from capture forms provided by field personnel. In addition, summary data collected by Helga Pac for the Grizzly Bear Programmatic EIS were reviewed for development of a complete record for these activities in Montana. A database was created at the laboratory to record all problem incidents in Montana. This will be updated annually in cooperation with the state endangered species biologist. Records from 1991 are being completed and will be reported in the next year's report.

To accurately measure annual variation in these activities, several definitions were developed. A relocation included movements within a bear home range as well as far outside. However, movements within home ranges (short distance) are indicated in the record. A problem case was the situation leading to control actions. Relocations includes each individual relocation (e.g. if mother and cubs are split up, the relocations are independent relocations). A problem incident is a reported situation which demands attention or is a significant interaction between bear and humans or their property or livestock.

In the NCDE during 1990, ten bears were relocated as a result of nine problem incidents. One incident involved two bears (bears 135 and 137), and one bear was relocated twice during the year (bear #9-10). One bear was eventually removed from the ecosystem. One bear was moved within its home range and has remained there. Four bears returned to the areas from which they were moved. Records of three others are incomplete, and their fate is not known at this time. Two relocation efforts occurred in May, two in June, one in July, one in August, two in October, and one in November.

Comparisons of the last three years shows the significant amount of variation in these activities from year to year (Table 16). These variations are probably a result of short-term environmental changes which can be natural or human caused (e.g. drought, food failures, corn spills, etc.). A significant amount of relocation activity occurs on both the east and west sides of the Continental Divide. Most of the relocation activity is oriented toward females by management direction. Therefore, the ratio of females/males over time will be skewed. Many males involved in problems will be more readily removed from the ecosystem. A more complete analysis of the success of relocation efforts in the NCDE is being prepared by MDFWP biologists (Appendix D).

Table 16. Summary of grizzly bear relocations in the Northern Continental Divide during 1988-1990.

Year	No. Bears	No. Cases/Relocs.	Sex Ratio	No. Killed	No. on East/West
1988	3	3/3	1M/2F	1	3E/0W
1989	15	10/12	6M/9F	2	6E/4W
1990	9	9/9	3M/6F	1	3E/6W
Total	27	22/24	10M/17F	4	12E/10W

Records from the Animal Plant and Health Inspection Service, Animal Damage Control Division are filed at the laboratory annually. A statewide summary of black and grizzly bear control activities from 1967-1990 was conducted to determine trends in these activities (Fig. 10). The number of control actions varied from year to year. However, trend lines indicate that the actions have been stable to slightly increasing for this time period. Control kills have been reduced in recent years because many bears were relocated rather than destroyed. A notable decline in control actions is evident for the early 1970s until 1975. More recent years suggest that the number of livestock conflicts with bears has risen since the early 1970s.

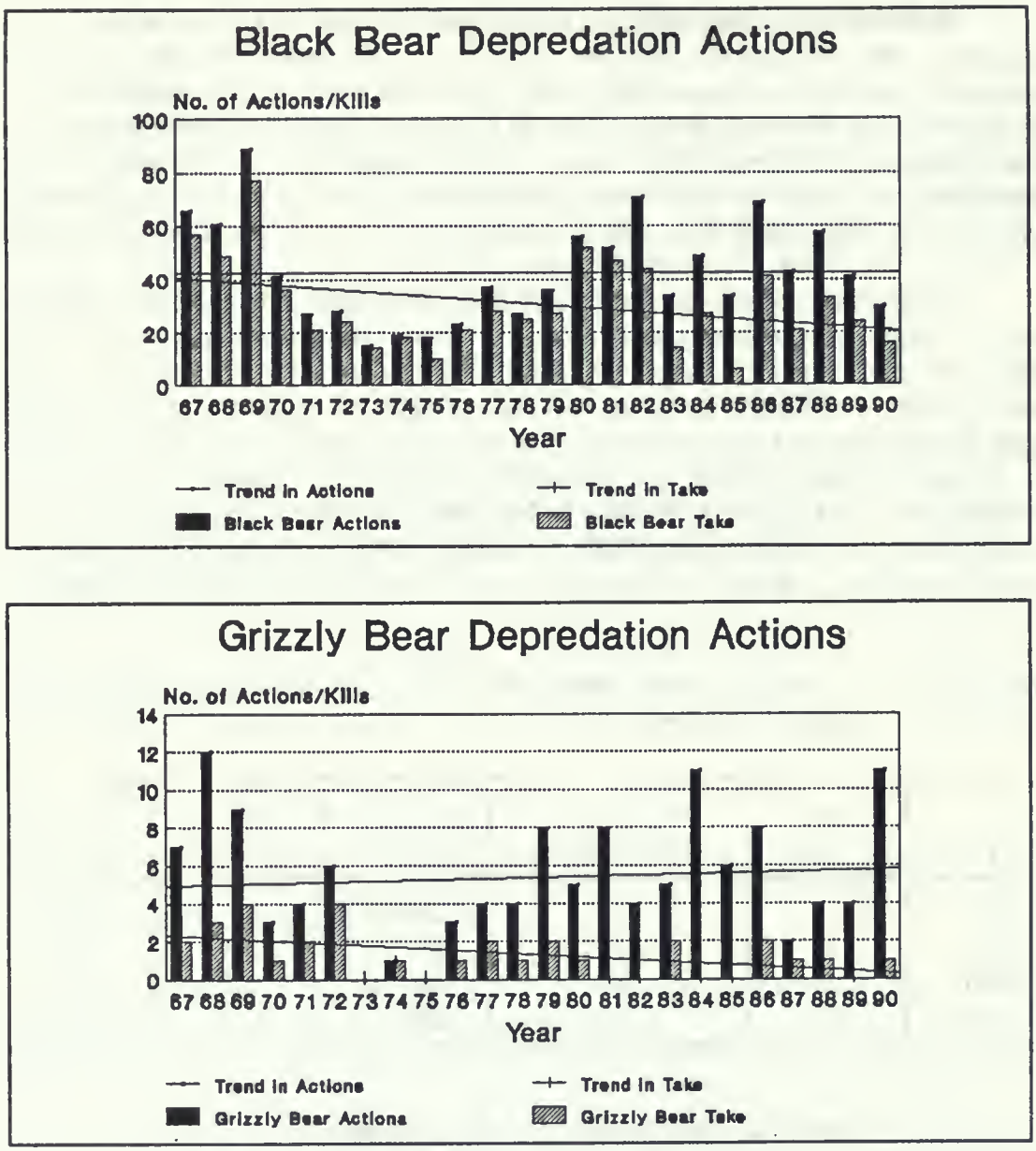


Figure 10. Animal Damage Control activities in Montana 1967-1990.

Disposition of 1990 Grizzly Carcasses

The annual summary of grizzly bear mortalities in 1990 is reported in Pac and Dood (1991). A total of 23 mortalities were reported for the year. These included four live removals. Parts were obtained from 13 of the 19 carcasses available. Four grizzlies went to Wyoming and were not examined in the MDFWP laboratory. Skulls were obtained from 11 grizzlies. One skull was returned to a hunter, two skulls were given to Yellowstone National Park, two are being held as evidence, and the remainder are in

MDFWP laboratory collections. Eight whole carcasses were received. Hides from four of these were not salvageable. The remaining four hides were salvaged. One is being held as evidence, one was given to the Yellowstone National Park, and the remaining two are in MDFWP laboratory collections.

Wolf Mortality Studies

No formal wolf mortality recording process exists in Montana to date. A short summary of wolf mortalities as received by our laboratory was developed to begin formalizing a process. Old records were examined in the laboratory files to determine when and where wolves were killed in Montana in recent history (Table 17). At this time, the list is fairly complete but may be missing records of mortalities recorded by other agencies but not processed or reported to the laboratory. Several specimens were processed through the laboratory before a lab protocol was established. The record may be incomplete for these specimens.

Table 17. Wolf mortalities recorded through the MDFWP laboratory, 1956-90.

Year	Lab No.	Sex	Age	Weight (lbs.)	Cause of Death
1956	None	M	Ad.	86	Mistaken ID
1974	177049	F	5	--	Natural (skull found)
1978	177740	F	Ad.	83	Fatal Gun Shot
1981	178620	M	Ad.	110	Animal Control
1987	179649	M	4	101	Animal Control
1987	179656	F	Pup	39	Animal Control
1987	179657	M	Pup	58	Animal Control
1987	179659	F	4	--	Trapped
1988	179737	M	3	64	Roadkill
1989	179878	M	2	107	Animal Control
1989	179920	F	Pup	27	Relocation/Starvation
1989	179921	F	Pup	30	Relocation/Starvation
1989	None	M	Ad.	--	Illegal
1989	179946	M	2	--	Unknown (B.C.)
1990	180044	F	1	62	Animal Control
1990	None	F	Ad.	--	Relocated/Illegal
1990	None	M	Ad.	--	Roadkill
1991	None	F	Ad.	--	Illegal
1991	180237	M	Pup	--	Natural
1991	None	F	1	--	Animal Control
1991	180255	M	1	96	Illegal
1991	180256	F	1	80	Animal Control/Illegal?

Twenty-two wolf mortalities have been reported in Montana during the period 1956-1991. Most of these wolves (18) died since 1987 when wolf pack activity began in northwest Montana. Most of the mortality has included wolf pups, yearlings, and 2-year olds (61%).

Many of the earlier records came from northeastern Montana, while the later records come from northcentral and northwestern Montana. All records come from near the Canadian Border with the exception of a roadkill near Yellowstone National Park. Necropsy results of the latter animal indicated that it may have recently escaped or been released from captivity.

Mountain Lion Studies

Mountain Lion Morphology Study

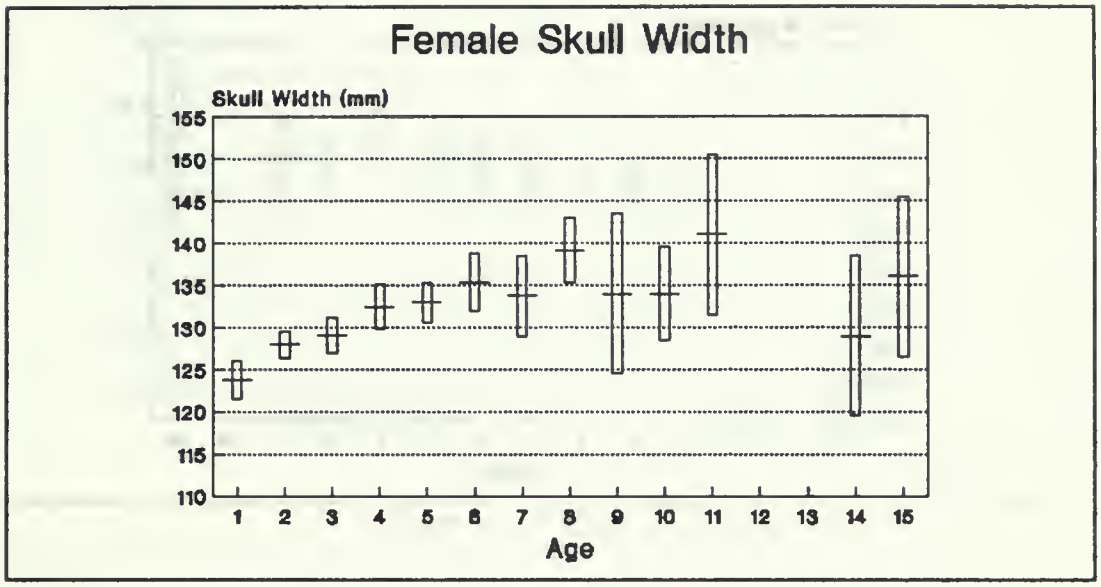
Skull measurements taken from hunter killed lions included skull length and skull width. A total of 130 female skulls and 285 male skulls were measured and then aged by cementum annuli counts to examine skull growth in Montana mountain lions (Figs. 11 and 12). Mean skull length generally increased until age 4 or 5. There were significant differences in the juvenile, one, two, and three year old male lions while in females only age classes juvenile and lions over one year of age were distinguishable by skull length and width. Skull size may be an indicator of age in the lower age classes when growth is occurring.

Canine diameter was measured from 117 female and 265 male mountain lions (Fig. 13). Canine diameter was significantly ($P<0.01$) different between sexes; male canines exceeded 13.5 mm and females were less than 13.5 mm. These data indicate that canine diameter could reliably sex mountain lions. With this information, we have examined all reported sexes and have found few discrepancies between reported sex and that indicated by canine diameter.

An ANOVA examination of skull length and width for male lions older than 1 year (adult lions) by MDFWP regions indicated that skull size did not vary between regions ($P<0.05$) (Table 18). The mean skull length of all adult males was 212.3 mm and mean skull width was 148.2 mm. Male mountain lions appear to be of similar size throughout the State of Montana.

Age Determinations of Lions

Lions were aged by cementum annuli counts (Trainer and Matson 1988) and suture analysis (Greer unpublished data). Cementum annuli counts were checked against several known-aged lions in our sample (Table 19). Some discrepancies were noted in several lions. The skull measurements obtained for each lion indicated that length and width were generally incrementally larger with age. This suggests that the premolar ages



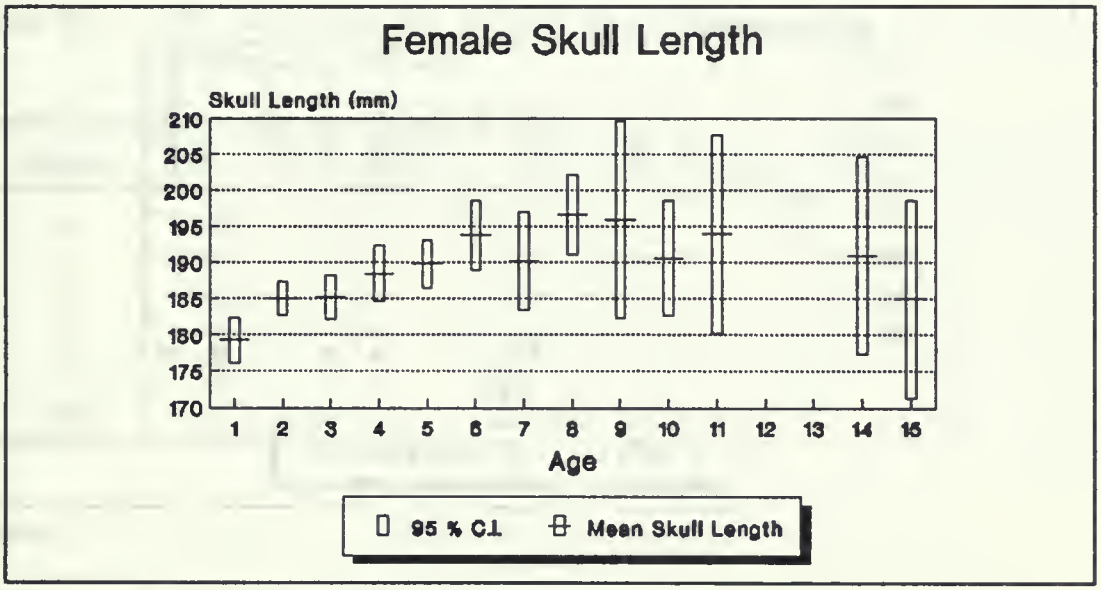


Figure 11. Skull characteristics of female mountain lions.

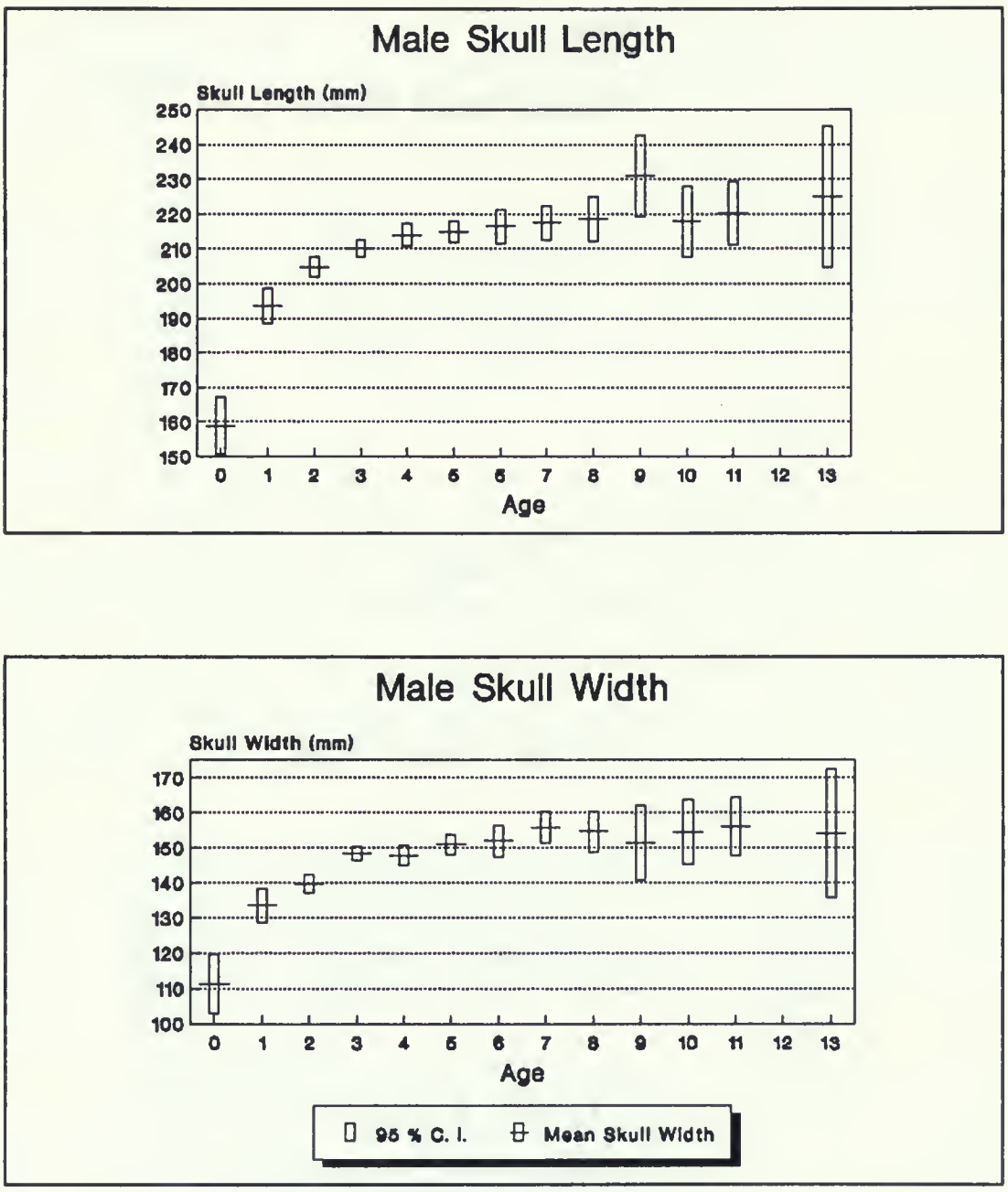


Figure 12. Skull characteristics of male mountain lions.

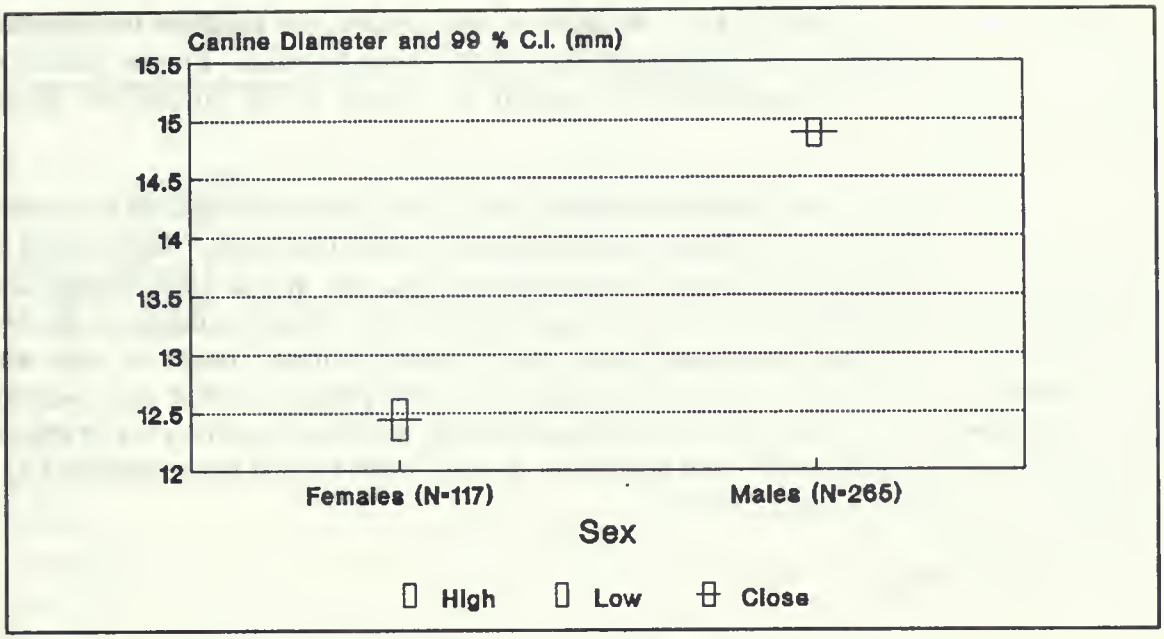


Figure 13. Comparison of canine diameter for male and female mountain lions.

Table 18. The mean length and width of male mountain lion skulls by each region in Montana, 1988-1990.

Region	N	Mean Length	95% C. I.	Mean Width	95% C. I.
1	97	212.3	210.2-214.5	148.8	146.7-150.9
2	83	212.9	210.6-215.2	147.3	145.1-149.5
3	34	213.1	209.5-216.6	150.0	146.2-153.7
4	33	213.5	209.9-217.2	146.7	143.1-150.3
5	25	207.5	203.3-211.7	149.6	145.6-153.6
Total	264	212.3	211.0-213.5	148.2	147.0-149.5

Table 19. Comparison of known aged lions and cementum annuli counts.

Lab No.	Known Age	Suture Class	Cementum Annuli	Sex
4182	9-10	VII	5B	F
3353	6	VI	8B	F
3348	3	III	7B	M
4651	18 Mo.	II	2B	M

may be indicative of increasing age. In addition, age distributions followed the expected pattern from 1988-1991, also suggesting that the ages may be valid. Further testing is needed to determine the accuracy of premolar cementum annuli counts for ageing mountain lions.

Suture analysis was conducted on 202 skulls which were also aged by cementum annuli counts. The suture analysis discriminated lions into 10 classes. Regressions of the suture class against the premolar age indicated that the suture class method did broadly class animals according to increasing premolar age. Cross tabulation of the two data indicated that the suture age classes may include a broad range of ages and discrimination of specific age classes was vague. Assuming that cementum annuli counts are valid ages, the suture classes discriminated kittens, yearlings, and to a lesser degree 2-year olds fairly well but did not accurately classify lions by age when premolar age indicated lions were 3 years and older.

Lion Mortality Study

Total lion mortalities recorded for 1988-89, 1989-90, and 1990-91 were 163, 193, and 255 respectively. The number of recorded non-hunting mortalities increased from 4 in 1988-89 to 28 in 1990-91 (Table 20). Self-defense cases, animal damage control, and nuisance lions added significantly to the number of nonhunting mortalities. A significant increase in the hunting mortalities occurred during 1990-91. All 5 regions reported higher numbers of hunter kills during 1990-91 as compared to the previous years (Table 20). Regions 1 and 2 accounted for 62.6% of the 88-89 mortalities, 69.6% of the 89-90 mortalities and 65.9% of the 90-91 mortalities.

1990-91 Mountain Lion Harvest Age and Sex Structure

Hunting mortalities were 159, 168, and 227 in 1988-89, 1989-90, and 1990-91, respectively. The harvest trend since 1983 has been increasing slightly (Fig. 14). Aune (in press) has shown that the lion harvest has increased significantly and steadily from 50 lions in 1970 to over 200 in 1990. The sex ratio of the harvest was similar for all three seasons form 1988-1990 (Table 22). Harvest statistics were summarized for each hunting district in Montana (Table 23). Many districts showed significant increases in lion harvest for the three year period.

The age structure of the statewide harvest has shifted upward steadily for the past three years (Fig. 15). Lions aged 3 and older have been increasing while the number of lions aged 1 and 2 have decreased during the three hunting seasons. The mean age of mountain lions in the harvest has increased significantly ($P < 0.05$) from 1988-89 to 1990-91 (Fig. 16). Mean age rose from 3.1 in 1988-89 to 4.4 for 1990-91 while the median age rose from 3 to 4. There was no difference in the mean age of lions between regions for each of the three annual hunting seasons compared ($P < 0.05$) (Table 24). Mean age

Table 20. Total mortalities by class of mortality, 1988-89, 1989-90, and 1990-91.

Mortality Class	Number of Lions			Percentage		
	1988-89	1989-90	1990-91	1988-89	1989-90	1990-91
Accidental Snare	2	3	0	1.2	1.6	0.0
Animal Damage Control	0	4	5	0.0	2.1	2.0
Nuisance Control	0	1	6	0.0	0.5	2.4
Human Threat	0	2	2	0.0	1.0	0.8
Illegal	0	2	1	0.0	1.0	0.4
Dogs	2	0	0	1.2	0.0	0.0
Road Kill	1	4	2	0.6	2.1	0.8
Self Defense	0	5	5	0.0	2.6	2.0
Train	0	1	1	0.0	0.5	0.4
Natural	0	2	5	0.0	1.0	2.0
Unknown	0	1	1	0.0	0.5	0.4
Subtotal	5	25	28	2.4	13.0	11.2
Hunting						
Archery	30	38	44	18.4	19.7	17.3
Handgun	69	71	94	42.3	36.8	36.9
Rifle	60	57	86	36.8	29.5	33.7
Unknown	0	2	3	0.0	1.0	1.2
Subtotal	159	168	227	97.6	87.0	89.1
TOTAL	163	193	255	100.0		

Table 21. Lion mortalities by MDFWP Regions, 1988-89 and 89-90.

< Region	1988-89		1989-90		1990-91	
	Hunting	Nonhunting	Hunting	Nonhunting	Hunting	Nonhunting
1	50	1	66	10	84	13
2	50	1	50	9	64	7
3	18	2	18	2	27	3
4	23	0	21	2	30	1
5	18	0	12	2	21	4
7	0	0	1	0	1	0

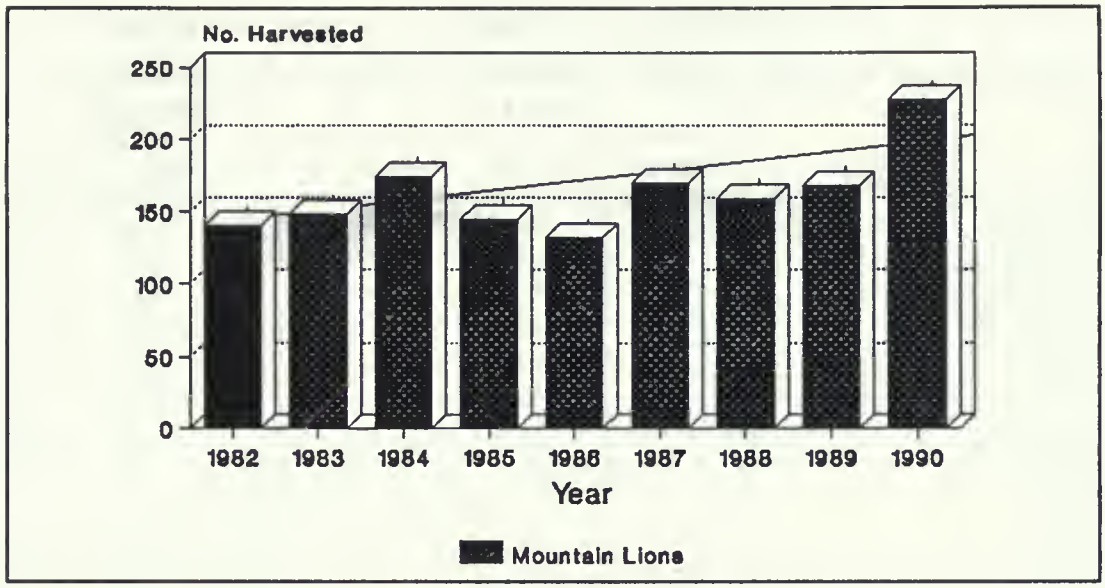


Figure 14. Mountain lion harvest trend, 1982-1990.

Table 22. Sex ratios of harvested mountain lions 1988-1990.

Sex	Frequency			Percentage		
	1988-89	1989-90	1990-91	1988-89	1989-90	1990-91
Males	111	124	155	70.3	73.8	68.3
Females	47	44	72	29.7	26.2	31.7

increased annually from 1988-89 to 1990-91 in all five regions with a significant lion harvest.

The data examined indicate that a cohort of lions born in 1987-88 has had a significant impact on the age distribution and mean age of the lion harvest. The affect of this cohort appears to be occurring statewide. This cohort may explain the impulse in lion incident activities reported by Aune (in press). The long term impact of this cohort on lion populations could be an increase in distribution of lions within the state as young lions recolonize previously empty habitats.

Table 23. Mountain lion harvest by hunting districts, 1988-89, 1989-90 and 1990-91.

Hunting District	1988-89	1989-90	1990-91	Total
100	5	11	12	28
101	4	6	7	17
102	1	4	4	9
103	9	1	6	16
110	3	6	6	15
120	1	4	4	9
121	9	10	12	31
122	1	5	5	11
123	5	6	6	17
130	9	10	9	28
140	2	1	5	8
141	0	1	1	2
150	1	0	1	2
170	0	1	0	1
200	1	1	3	5
201	4	6	6	16
202	7	10	6	23
203	6	1	4	11
204	0	5	4	9
210	3	2	4	9
212	2	0	3	5
215	0	1	0	1
216	2	2	2	6
240	6	2	8	16
250	7	8	10	25
270	1	1	1	3
281	2	3	3	8
283	3	2	4	9
285	2	1	1	4
291	1	1	1	3
292	1	2	1	4
293	2	2	1	5

Table 23 continued.

Hunting District	1989	1990	1991	Total
300	2	0	1	3
301	1	2	2	5
302	1	3	2	6
312	1	0	1	2
313	2	1	1	4
314	2	1	2	5
317	1	2	2	5
320	1	0	1	2
322	0	1	0	1
330	1	0	0	1
331	1	0	3	4
360	2	3	1	6
362	1	0	1	2
390	1	0	2	3
392	1	4	2	7
393	0	1	0	1
410	1	0	1	2
411	1	0	1	2
412	0	1	3	4
413	2	0	6	8
414	2	0	0	2
416	2	1	1	4
422	1	2	0	3
424	4	0	2	6
427	1	0	1	2
429	0	2	0	2
432	0	4	1	5
441	3	4	2	9
442	3	2	5	10
443	1	0	2	3
448	0	3	0	3
449	1	0	0	1
454	1	2	0	3
511	1	0	1	2
520	6	4	5	15
530	2	0	1	3
540	1	2	3	6
560	6	5	7	18
575	1	1	2	4
590	1	0	0	1
704	0	1	0	1

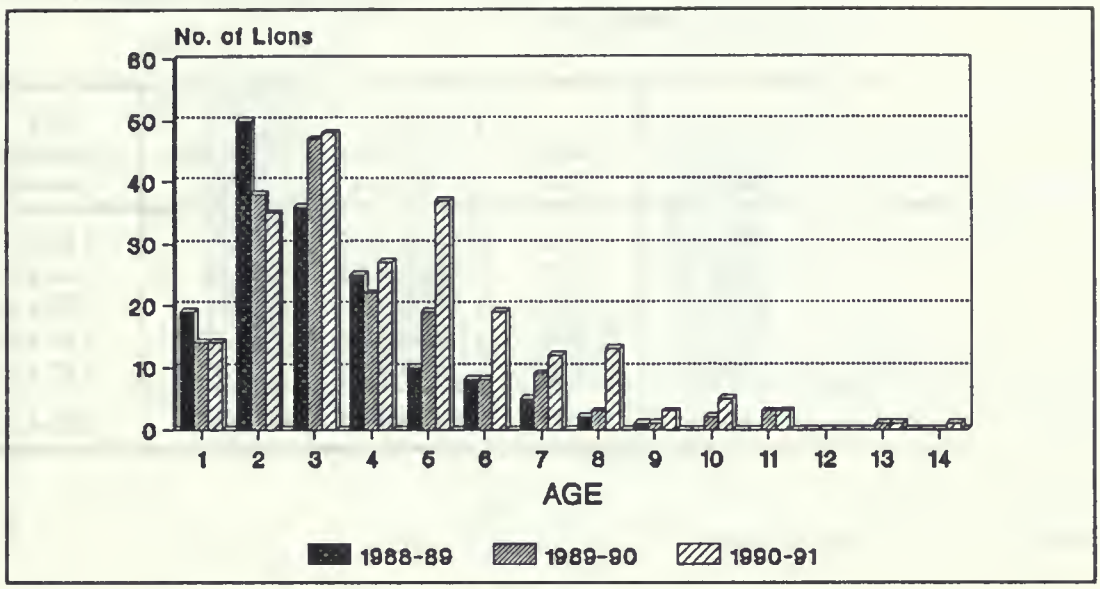


Figure 15. Age structure of the mountain lion harvest, 1988-1991.

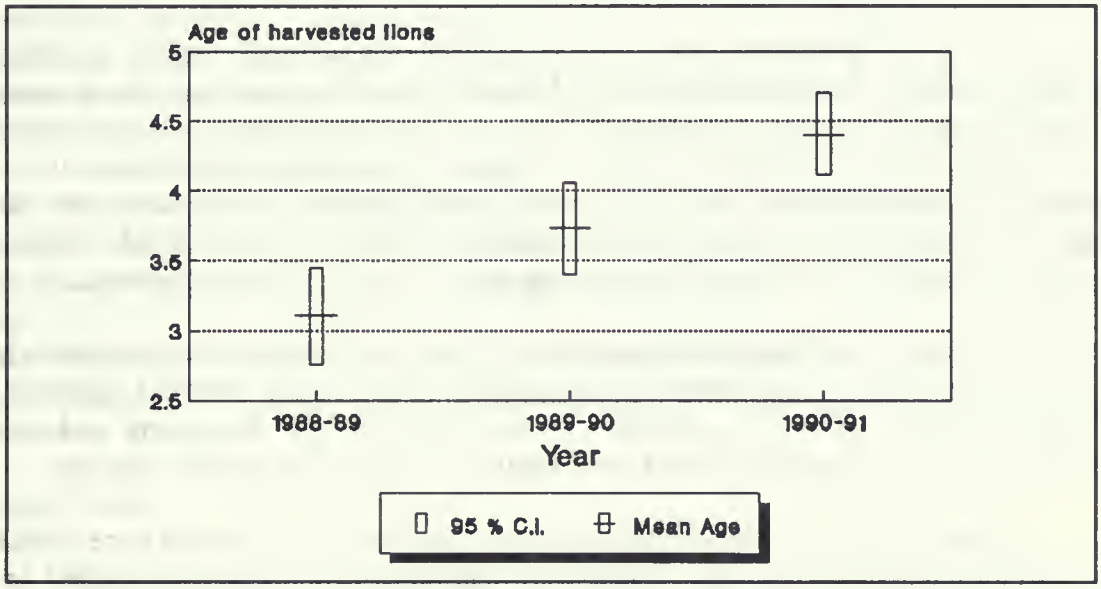


Figure 16. The mean age and 95 % confidence interval of harvested mountain lions during 1988-89,1989-90, and 1990-91.

Table 24. The mean age and 95% confidence intervals for annual regional harvests of mountain lion 1988-1991.

Region	Mean Age 88-89	95% Confidence Interval	Mean Age 89-90	95% Confidence Interval	Mean Age 90-91	95% Confidence Interval
1	2.92	2.46-3.38	3.53	3.00-4.08	4.39	3.85-4.93
2	3.18	2.72-3.65	4.10	3.48-4.72	4.08	3.46-4.71
3	2.53	1.73-3.32	4.39	3.36-5.42	5.71	4.72-6.70
4	3.43	2.71-4.14	2.90	1.95-3.86	4.07	3.18-4.95
5	3.53	2.73-4.32	3.83	2.57-5.10	4.52	3.47-5.58
Total	3.11	2.85-3.37	3.73	3.39-4.07	4.40	4.08-4.73

Human/Lion Interactions Study

During the period from July 1989 until August 1991, interactions of mountain lions and humans were monitored. Records of interactions were compiled from regional newspaper articles, MDFWP written case reports, USFWS Disposition Reports, and necropsy reports from the MDFWP wildlife laboratory. A total of 69 incidents confirmed by wildlife officials were recorded. These reports do not include incidental sightings near homes or communities. Other reports were received by phone or written correspondence but could not be confirmed by official reports.

Actions of the lions were classified as involving livestock attacks, pet attacks, nuisance situations, predatory/aggressive behavior toward humans, and human attacks. All human attacks required actual contact with the human and resulting injuries inflicted by the cat on humans. Predatory/aggressive behavior exhibited toward humans involved charges and sneak approaches toward humans, clawing the air, and vocalizations. In all aggressive exhibits, no actual contact is made with the human involved. Nuisance situations involved lions frequently seen near homes, ranches, or communities.

A complete summary of previous lion incidents in Montana was compiled in May 1991 for submission to the human-lion interactions symposium in Denver (Appendix E). The complete paper will be available soon. This project is ongoing and results summarized in this report include a brief summary of the more current findings.

Twenty-seven (39.1%) of the 69 incidents reported in this period were classified as livestock attacks (Fig. 17). Lions were captured then relocated or killed in 14 (51.9%) of these livestock cases. Nineteen of the cases (70.4 %) involved sheep. Other reported incidents of mountain lion interactions with livestock included poultry, cattle, and horses. Livestock cases occurred mostly throughout the April-October period.

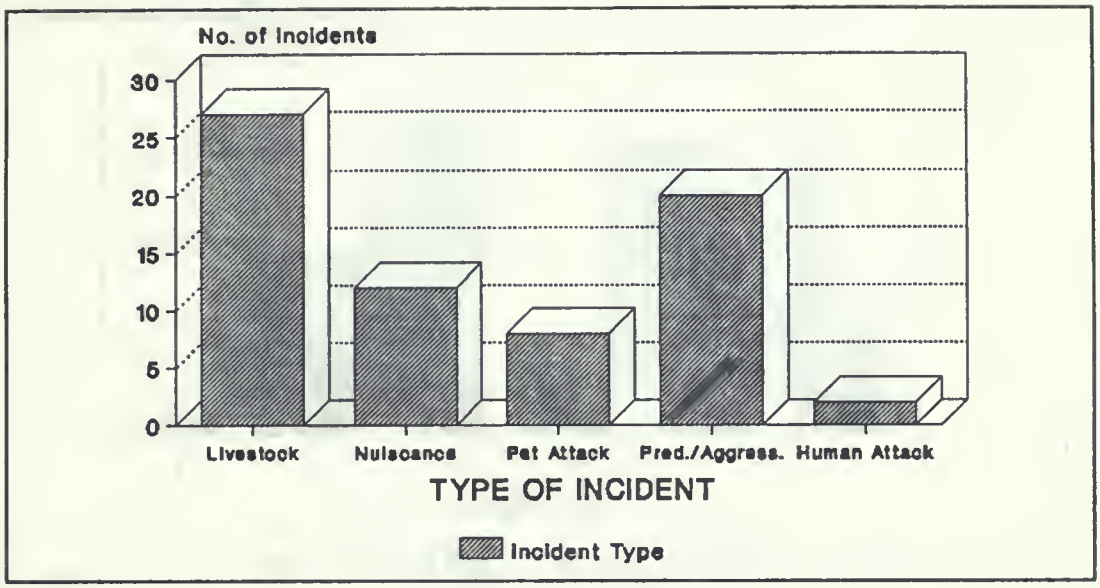


Figure 17. Frequency of mountain lion incidents by class in Montana, 1989-1991.

Twenty-three incidents were reported in fiscal year 1990 while 46 incidents were reported in fiscal year 1991 (Fig. 18). The number of incidents reported in 1991 was significantly higher in all regions of the state with the exception of Region 6 where few incidents are recorded. The most significant increase in human-lion interactions occurred in Region 1. Livestock-lion interaction is more consistent in Regions 4 and 5 while human-lion interactions were observed more frequently in Regions 1 and 2 (Fig. 19).

Aune (in press) found that the ratio of males to females is consistently skewed toward males for livestock-lion interaction while females are more prevalent in human-lion interactions (Fig. 20). Ages were recorded for 36 of the lions involved in the 69 incidents. Twenty-six (72.2%) of the lions involved in interactions were aged as 2 or less (Fig. 21). Aune (in press) hypothesizes that most of the lions are dispersing subadults. Further investigations confirm that most of the lions are young subadult. This is consistent with the impulse of a strong age cohort found in the age distribution of the harvest.

Bobcat Studies

Bobcat skulls were collected from trappers in Regions 2 and 3 during the 1988-89, 1989-90, and 1990-91 trapping seasons. Age was determined by examining the pulp cavity to discern juveniles followed up by cementum annuli counts for those not classified as juvenile. The mean age of bobcats collected in Regions 2 and 3 combined has declined slightly since 1988 (Table 25).

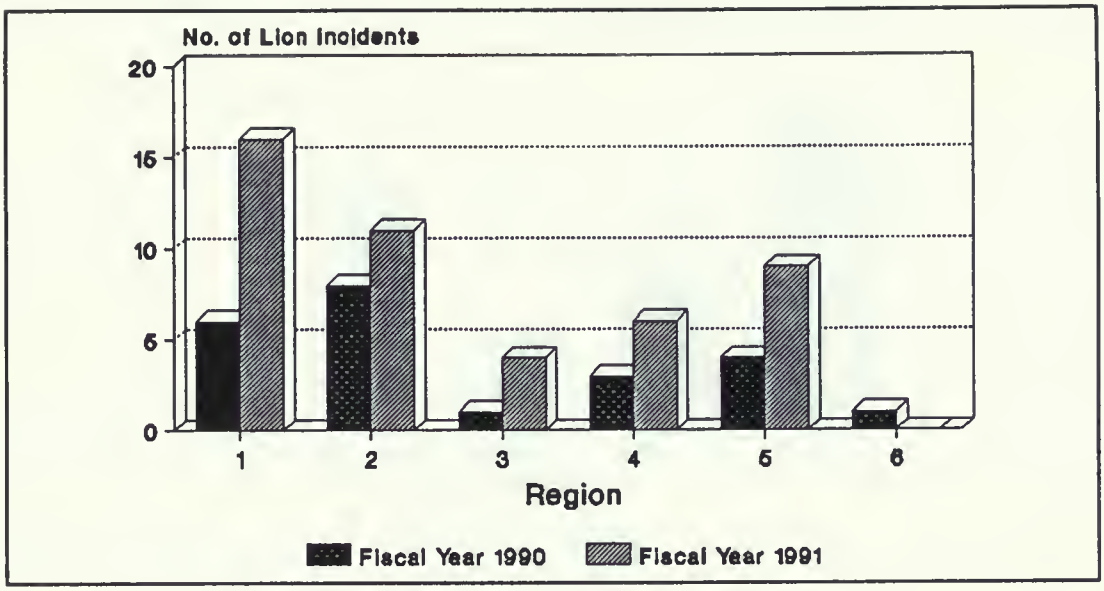


Figure 18. Comparison of reported lion incidents in Montana for Fiscal years 1990 and 1991.

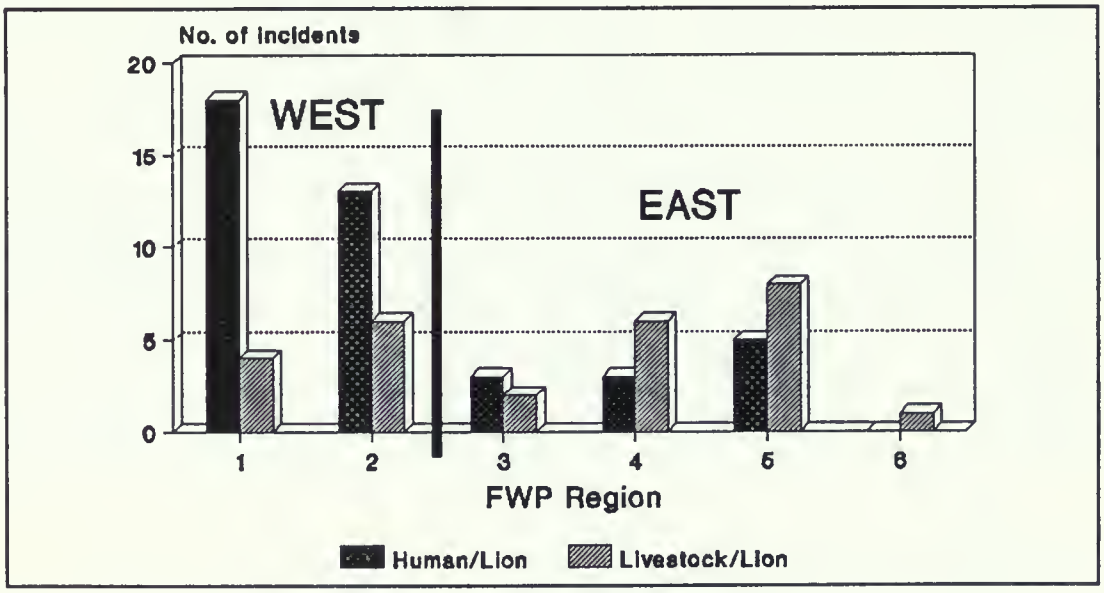


Figure 19. Frequency of mountain lion incidents by MDFWP administrative region, 1989-1991.

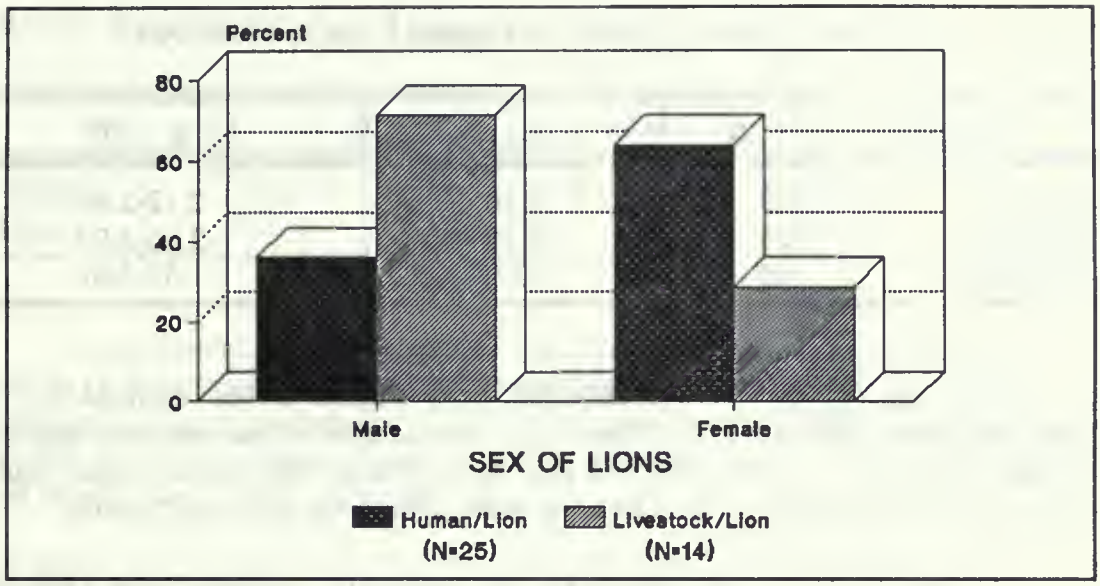


Figure 20. Sex ratio of mountain lions involved in human-lion and livestock-lion interactions in Montana, 1989-1991.

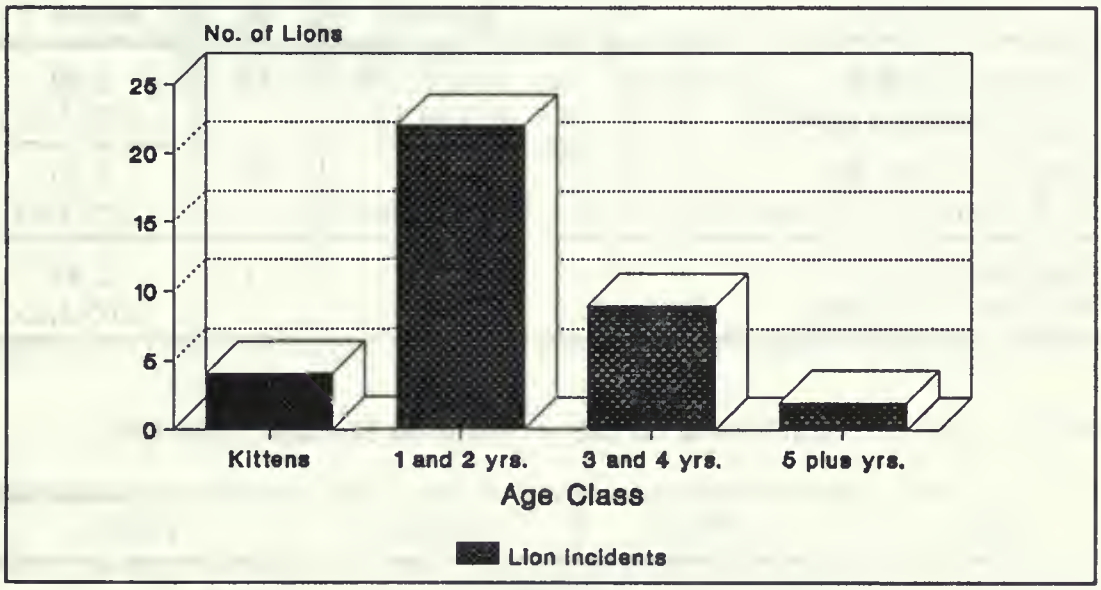


Figure 21. Age class of lions involved in all lion incidents in Montana, 1989-1991.

Table 25. Mean age of bobcats collected in Regions 2 and 3, 1988-1990.

Year	N	Mean Age	95 % C. I.
1988-89	129	2.50	2.12-2.88
1989-90	106	2.48	2.06-2.90
1990-91	68	2.09	1.57-2.61

Mean age of the bobcats collected from Region 2 has declined but not significantly from 1988 to 1990 (Table 26). The sample of bobcats from Region 3 declined significantly during 1990 and may have affected the results. Mean age of bobcats collected in Region 3 has remained stable during the three year period.

Sex ratio of the collected skulls was not significantly different from 1988-1990 (Table 27). Sex ratio of bobcats harvested for the three year period were not significantly different between Regions 2 and 3 (Table 28). Statewide during this period the ratio was 58.6% males and 40.1% female.

Table 26. Mean age of bobcats by year and region, 1988-1990.

Parameter	N	Region 2	N	Region 3
Mean Age 1988-89 95% Confidence Interval	25	2.22 1.31-3.13	41	2.60 1.89-3.31
Mean Age 1989-90 95% Confidence Interval	83	2.54 2.08-2.96	20	2.10 1.21-2.99
Mean Age 1990-91 95 Confidence Interval	45	1.88 1.37-2.37	17	2.44 1.63-3.25

Table 27. Sex ratio of harvested bobcats in Southwest Montana, 1988-1990.

Sex	1988-89	1989-90	1990-91
Female	50.0	40.8	41.5
Male	50.0	59.2	58.5

Table 28. Sex ratio of harvested bobcats by MDFWP region, 1988-1990.

Sex	Region 2	Region 3	Total
Female	38.5	45.5	40.6
Male	61.5	54.5	59.3

An age distribution for Regions 2 and 3 combined was developed (Fig. 22). The number of juveniles has remained stable during the last three trapping seasons. The number of one year old bobcats dropped substantially in the 89-90 trapping season. A significant change in the percent of 2 and 3 year old bobcats occurred from 1988-1990. Few bobcats were aged over 9 years old.

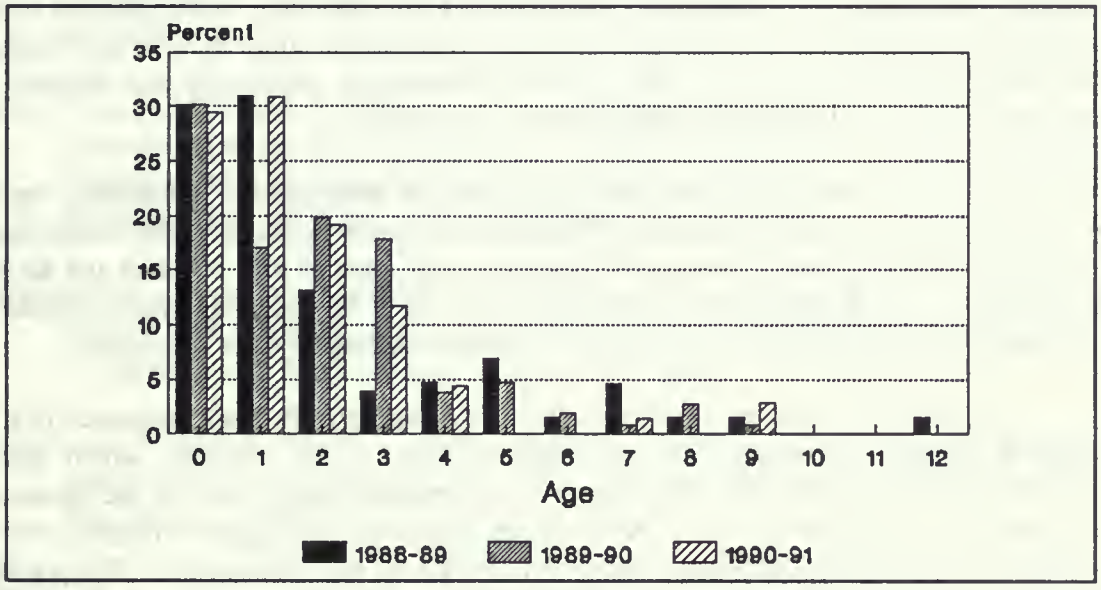


Figure 22. Age distribution of bobcats collected from trappers in Regions 2 and 3, 1988-1990.

RECOMMENDATIONS

The wildlife laboratory services should be continued. Sufficient flexibility should be maintained in order to be able to readily respond to changing needs of Department wildlife management and research biologists.

Work emphasis should be directed at building computer data files from large raw data compilations so that information is more readily available to biologists and managers. Computer assisted data analysis should be continued to publish and distribute data on many topics of interest including mountain lion harvest data, food habits, reproductive performance of selected species, disease and parasites of selected wildlife, and blood profiles.

Pine marten carcass collections should continue. However, the funding of this program should be more specifically directed to the laboratory so that budgeting and manpower planning can be more easily conducted.

The mountain lion trophy process should be modified to help speed processing of hunter killed lions. A clear copy of the trophy form should be immediately sent to the laboratory as well as Helena and the regions so that processing can be conducted on each specimen immediately. Under the current process the laboratory must wait for trophy forms to be transmitted from Helena Enforcement Division after they have completed their use of the forms. This delay prevents immediate processing and delivery of processed skulls until the trophy sheet arrives from Helena.

A bobcat skull collection process should be developed if additional regions participate in bobcat skull collections. The current situation results in many bobcat skulls with limited information as to the sex, location of kill, date of kill, or name and address of trapper. A tagging process similar to that used for mountain lions should be considered to assure correct tagging and reference marking of each specimen.

The establishment of a protocol for processing grizzly bear carcasses has the potential to greatly increase our knowledge of bears. All carcasses which can be reasonably obtained from the field should be immediately transported to the laboratory or frozen for later examination. A concerted effort by all regions involved will be necessary and complete cooperation from field personnel will be essential. The potential exists for functional anatomy study and serious disease and parasitology studies with the materials available from the field.

Relocating grizzly bears to resolve human/bear conflict is frequently applied in both the Yellowstone and Northern Continental Divide Ecosystems. Record keeping in the Northern Continental Divide is not often available for consistent review and analysis. It is recommended that copies of problem bear capture forms, flight reports, and interagency nuisance report forms from the NCDE be forwarded to the Wildlife Laboratory for filing and record keeping. Annual summaries of the information should be completed. This will provide accurate and long term record keeping of relocation efforts for review by grizzly bear managers.

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Appendix A

THE REPRODUCTIVE PERFORMANCE OF FEMALE GRIZZLY BEARS IN THE NORTHERN CONTINENTAL DIVIDE ECOSYSTEM.

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Abstract: The reproductive performance and cub litter survival of female grizzly bears were analyzed for all Northern Continental Divide (NCD) grizzly bears killed or radio instrumented, 1969-90. Reproductive tracts of 44 female grizzly bears from the NCD and Yellowstone Ecosystems were examined for corpus lutea and graffian follicles to estimate reproductive potential. The average number of corpus lutea was 2.45. Average cub litter size in the NCD was 2.20. Cub survival was 0.90 and yearling survival was 0.86. Sixteen reproductive intervals were determined for 10 individual bears and averaged 2.69 years. The minimum age of reproduction ranged from 4 to 7 and averaged 5.7 years. Survival of known 1st litters was less than the average for all females when adjusted for the loss of an entire litter.

Appendix B

HELMINTHS OF THE MOUNTAIN LION, *FELIS CONCOLOR* IN MONTANA

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Abstract: The helminth fauna of 58 mountain lions, *Felis concolor* L., was determined by examination of the gastrointestinal tracts and muscle samples of hunter killed animals supplied by the Montana Department of Fish, Wildlife and Parks. The gastrointestinal tracts were opened, washed, screened, and the contents examined for helminth parasites with the use of a macroscope. Pepsin/HCL digest techniques were used to detect *Trichinella spiralis* in 25 gram muscle samples. Helminths found included three species of cestodes: *Taenia omissa* (53%), *Taenia pisiformis* (< 1%), and *Atriotaenia procyonis* (2.5%); four species of nematodes: *Ollulanus* sp. (< 1%), *Toxascaris leonina* (43%), *Physaloptera praeputialis* (2.5%), *Trichinella spiralis* (25%), and one trematode species, *Alaria marcianae*. *Atriotaenia procyonis*, a raccoon parasite, *Ollulanus* sp., a domestic cat parasite, and Taenia pisiformis, a domestic dog parasite, have not been reported previously from mountain lions.

Appendix C

AGE, SEX AND POPULATION SPECIFIC INCIDENCE OF TRICHINELLA SPIRALLIS IN BEARS.

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Abstract: The specific incidence of Trichinella spirallis within various age, sex or population densities of bears was explored. Peptic digests from 509 black bear and 312 grizzly bear tissues collected 1969-1989 were examined for trichinella larvae. The parasite was found more frequently in grizzly bears than black bears. The average LPG was higher in grizzly bears (50.4) than black bears (39.0). The parasite was slightly more common in male bears than female bears. The incidence of trichinella increased as age increased. The relationships of population density, geography and regional food habits to the presence of the parasite are discussed. Potentials for interspecific transmission are addressed.

Appendix D

TRANSLOCATION OF NUISANCE GRIZZLY BEARS IN NORTHWESTERN MONTANA.

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Translocation has been one of the most prominent and widely used methods to control mortality of grizzly bears. In most instances, however, there has been an inadequate evaluation of this management action. We examined 10 variables from 83 translocations (15 years) in the northern continental divide grizzly bear ecosystem to determine factors affecting translocation success, and to develop a predictive tool for managers involved in decisions regarding translocations. We also provide a description of the types and extent of problems that have occurred and the types of bears involved, the costs of past translocations, and management recommendations for the future.

Appendix E

INCREASING MOUNTAIN LION POPULATIONS AND HUMAN-LION INTERACTIONS IN MONTANA

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ABSTRACT

During 1989 and 1990, an increased number of human-lion conflicts occurred. These encounters included one serious mauling of a 9-year-old boy and the fatality of another male child. The hypothesis that increased lion populations were a factor in recent interactions with humans was tested. Information was compiled from 52 case reports of lion-human conflicts in 1989 and 1990. Nineteen (36.5%) of the conflicts involved livestock attacks. Other conflicts included predatory/aggressive behavior towards humans (32.7%), nuisance situations (15.4%), pet attacks (11.5%), and human attacks (3.9%). Age and sex determinations were made in 29 of the reported cases, and 16 lion carcasses were examined to determine the relative health of offending lions. The mountain lions examined were characterized as healthy but young lions. Sex ratios were even (45%F/50%M) for human/lion confrontations while the ratios were skewed toward males (20%F/80%M) for encounters involving livestock. Potential population indicators such as harvest trend, trend of animal damage complaints, and nonhunting mortality were examined. Harvest trend was strongly correlated with license sales (correl. coef. = 90.7, r-squared = 82.43). All indicators exhibited upward trends for the period 1971-1990. The relationship of these trends to supposed increasing populations are discussed. The hypothesis that increasing lion populations were a significant factor in the recent lion encounters was generally supported. However, critical population survey data are not available for analysis. Other causes for increased conflict, including human encroachment into lion habitat, are discussed.